# PRODUCT ENGINEERING

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## The Changed Picture

WHEN PRODUCTION METHODS, management and machinery were in their period of rapidly increasing efficiency, cost of manufacture was almost the sole consideration and relatively little emphasis was placed on design. There were reasons for that. At that time, the early years of the twentieth century, engineering design was in its infancy both as to the knowledge of the art and the materials available from which to create the design. Also, manufacturing methods were limited primarily to casting, cutting and grinding, and all designs had to be restricted by the cost limitations imposed by the few basic manufacturing processes available.

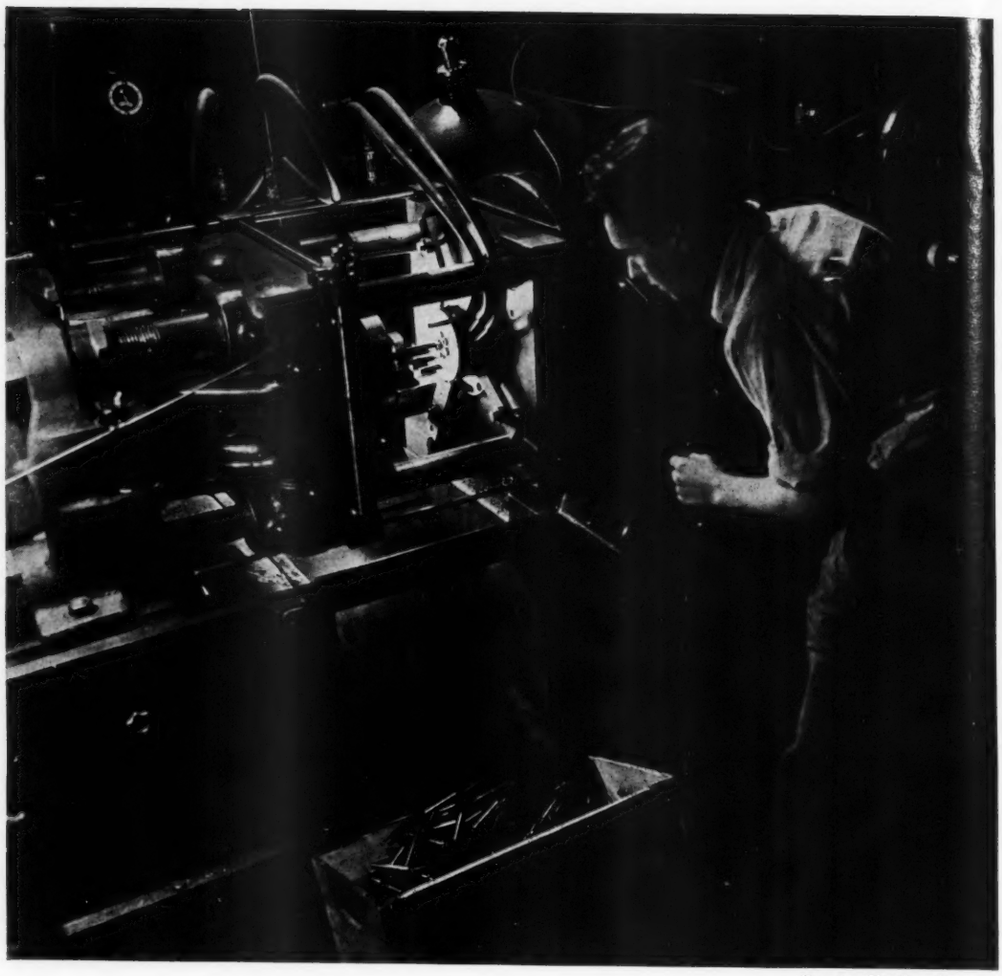
Along with the development of new manufacturing processes such as fusion welding, flame-cutting, resistance welding and die casting, new materials were made commercially available—aluminum, magnesium alloys, stainless steels and a host of others. The great plastics industry brought with it a new molding technique.

All this is just history and old-timers know the story processes such as fusion welding, flame-cutting, resistance when the shop did much of the designing and costlier metals were tabooed. The business philosophy that governed the manufacturing companies of bygone days demanded the use of the cheapest materials in the cheapest way to get the cheapest machine or product that would serve the purpose. The old Ford Model T was the last of the great examples of that era.

Many business and sales executives still live in the days of Model T. They expect their engineering department to design solely on a "manufacturing cost" basis and hound the production division to "get down costs." But the fact is that the trend is distinctly toward a levelling off in comparable manufacturing costs. No one manufacturer can obtain an advantage through the use of automatic machinery; such equipment can usually be purchased on the open market. Nor is there any monopoly on production-management brains. And as to labor rates, wages-and-hours laws and labor organizations are rapidly eliminating any possible advantages for one manufacturer over another.

Today manufacturing competition is no longer solely a matter of competition on the cost of shop operations. The competition is basically one in engineering design. The sales and service values of the materials used, the form and functioning of the machine or product, its form and color and numerous other design features determine its sales values. And the manufacturing costs will be determined largely by the ingenuity exercised by the engineer in the development of the design. If the sales values are sufficiently greater than the manufacturing costs, the product can be sold at a profit.

Elementary as this may sound, it does not seem to be fully recognized by many sales executives because the "sales mind" tends to emphasize price competition to the exclusion or secondary consideration of sales values. Also, the "sales minds" are loath to admit the salability of a new idea for theirs is the responsibility for marketing it. For which reason it is often necessary for the engineer to be a better salesman than the salesmanager. That is, if he expects to get his new design ideas accepted. But "engineering minds" generally are not good "sales minds." The only solution is a management that is fully awake and progressive and will not be satisfied with arbitrary opinions on the pro and con of new design ideas. Some companies have found the solution in a "new products division" which thoroughly and without prejudice investigates the market possibilities of new designs.



*Boonton Molding Company*

# MOLDED PLASTICS

## *Selecting the Material and Designing the Part*

C. W. BLOUNT, *BAKELITE CORPORATION*

**In this general discussion of organic plastics, comparative physical properties are presented in graphical form, and a selection table, summarizing the properties of the various common types, is included**

THE WIDE RANGE of plastic materials, with special physical properties to meet certain application requirements, makes the choice of the proper material difficult for the designer who is not well-versed in the plastics field. Data are available on the properties of the various plastics, but the mass of it is so large and the field of application so broad that it is hard to get a clear, comparative picture of physical properties of the more important classes of plastic molding materials.

At this point it should be emphasized that the data presented in this article are of value principally on a *relative basis* for a given property, and are to be used to judge how much better one material is then another for a *given property*. For instance, the data on which these graphs are based were obtained by testing standard test specimens under certain set conditions. One cannot assume that a material, which under A.S.T.M. test had a tensile strength of 5,000 lb. per sq.in., when molded in a different thickness and to a different shape will have 5,000 lb. per sq.in. tensile strength at any given cross section. It may be considerably less. This is also true of dielectric and other properties. Physical properties depend to a great extent on the shape and type of the molded piece. Comparative presentation does however show for what property each material is best, and what compromises must be made. No hard and fast rule can be stated for or against the choice of any material; as in other

design, the engineer must balance desired properties against first cost, availability, production cost and appearance.

It would be desirable to consider each group of materials by taking the best property of any one group. Unfortunately, there are a variety of materials produced in each class. For example, all cellulose acetate is not the same. The highest tensile strength material is the least flexible; the most flexible has the lowest tensile strength. In considering acetate, an average optimistic value of what can be obtained with one acetate or another has been used.

So with phenolics: they have been arbitrarily classified into low-loss, heat-resistant, shock-resistant, acid and alkali-resistant, and general purpose. These divisions by no means cover the properties of all the phenolics on the market today. They are used mainly to clarify the issue and avoid confusion, and represent the average optimum properties of each general class. All plastic properties have not been covered in these tables, but those given ratings are the properties occurring most frequently in design.

### *Physical Properties*

In the bar charts shown note that in relative toughness, cellulose acetate is much stronger than phenolic heat-resistant. On the other hand, the difference between heat-resistant phenolic and acid-resistant is slight and would not be worth consideration in design. Urea has the best relative flexural strength; while cellulose acetate, with high impact strength rates seventh in flexural strength and fourth in tensile strength.

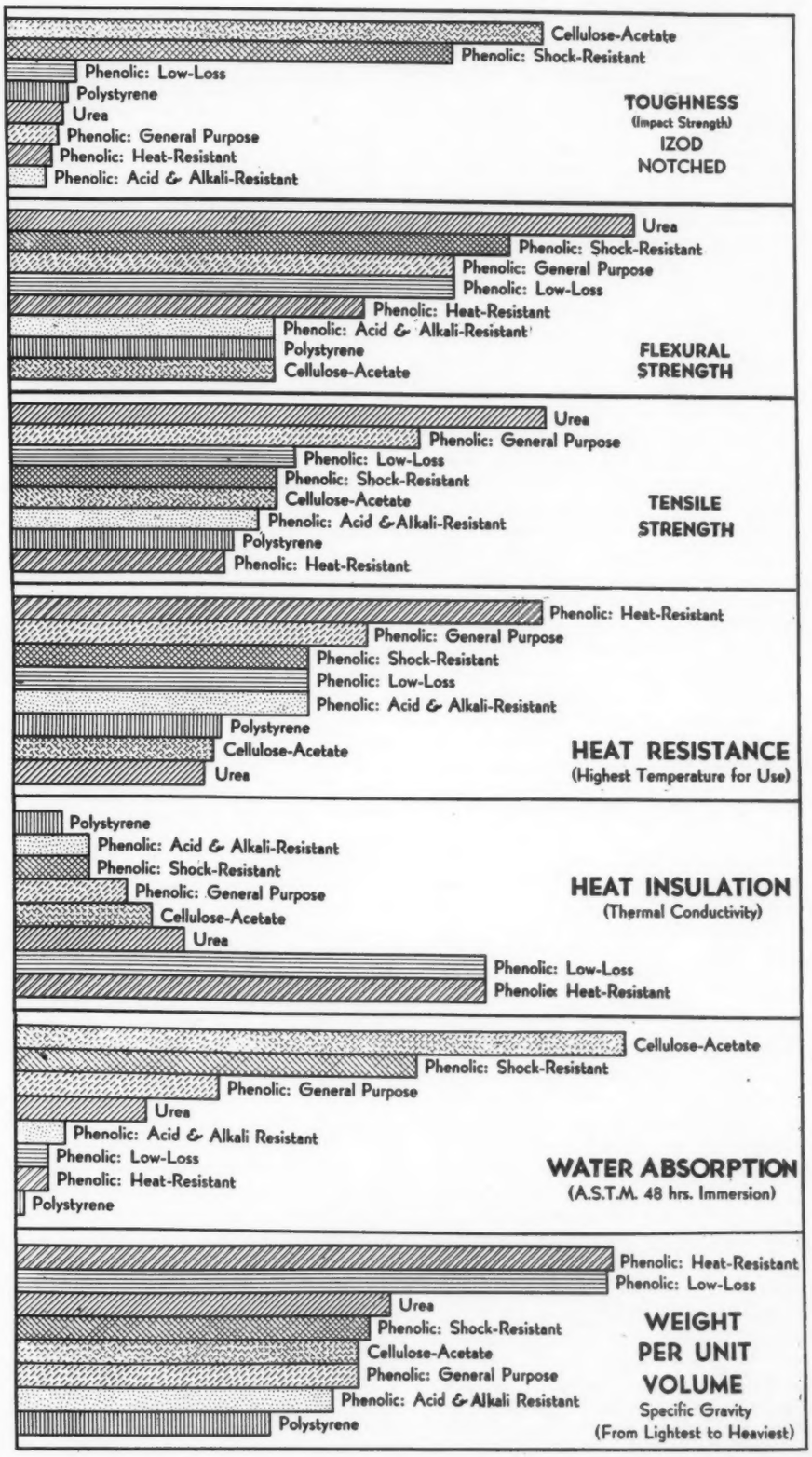
A common error made by engineers when designing with plastics is to ask for a material of a higher tensile strength when what they really desire is a material that is tougher, or has higher impact strength. For example, a manufacturer of heater plugs wanted a stronger material and asked for one of a higher tensile strength. On investigation it was found he had to meet a Fire Underwriters' specification which involved a multiple dropping of the assembled plug against a maple board. This calls for a material of higher impact strength.

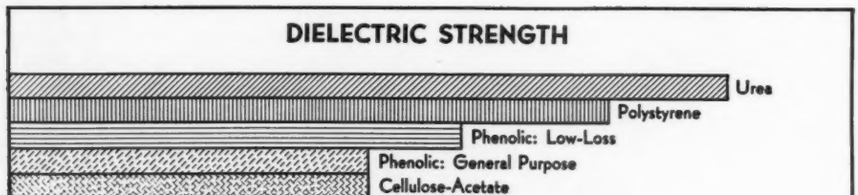
Color is uncharted because there are so many variations which depend on the types of raw materials used. However, the urea materials with proper dyes can be made in light colors which are unaffected on exposure to sunlight.

The chart on heat resistance indicates the relative temperature at which the plastic materials can be used continuously without serious effect on their properties. The word "continuously" must be stressed, for urea on the chart is rated below acetate. But, if you were to pour hot liquid into a cup made of acetate it would soften immediately, whereas urea would remain satisfactory.

Recently there has been consideration of plastics in refrigerators, and therefore, relative heat insulation characteristics are of interest. The barographs illustrate the relative thermal conductivity of the various materials. None of the plastic materials would be satisfactory for heat insulation to replace mineral wool or similar materials for the inside lining insulation for refrigerators. Their use is principally for breaker strips which separate the outside surface of the metal door from the inside surface. The plastics are poor conductors of heat: even with the material of highest thermal conductivity it is possible to carbonize one side without overheating the other side.

Comparative chemical resistance, rela-






**ELECTRICAL INSULATION PROPERTIES**

Power absorbed by Insulation, Relative Loss Factor (From Lowest to Highest)

| | 60 Cycles | 1,000 Cycles | 1,000,000 Cycles |
|---|---|---|---|
| ① Polystyrene | 1 | 1 | 1 |
| ② Phenolic: Low-Loss | 458 | 230 | 115 |
| ③ Cellulose-Acetate | 500 | 900 | 733 |
| ④ Urea | 740 | 670 | 600 |
| ⑤ Phenolic: General Purpose | 10,000 | 2,800 | 1,000 |
| ○ Phenolic: Acid & Alkali Resistant | — | — | Not Controlled |
| ○ Phenolic: Heat-Resistant | — | — | " |
| ○ Phenolic: Shock-Resistant | — | — | " |

**RESISTIVITY**

Lowest is considered 1 and Balance is Tabulated Relatively. Rated from Highest to Lowest (All are Good Insulators for Direct Current)

| | |
|---|---|
| ① Polystyrene | 10,000,000 |
| ② Phenolic: Low-Loss | 10,000 |
| ③ Phenolic: Acid & Alkali Resistant | 3,000 |
| ④ Urea | 2,000 |
| ⑤ Cellulose-Acetate | 500 |
| ⑥ Phenolic: General Purpose | 9 |
| ⑦ Phenolic: Heat-Resistant | 2 |
| ⑧ Phenolic: Shock-Resistant | 1 |

tive acid and solvent resistance and relative caustic resistance are shown by rating the materials by number in the summary table. Dimensional change in molding is shown in the same way. Most plastics shrink on removal from the mold and on cooling from 0.002 to 0.012 in. per in. This rating refers to that change in dimension that takes place after molding. For instance, in the humid summer, a urea top on a phenolic box can be removed with ease. In the winter time in a steam-heated atmosphere the urea top will shrink on the phenolic base so much as to cause binding and even breakage of the urea cover. There is also a natural tendency, under even ideal humidity and temperature conditions, for one type plastic to shrink more than another type.

Lightness of weight is often the reason a plastic is considered for a given application, such as storage battery cases for aircraft and outlet boxes for 10,000-ton Navy cruisers. The relative specific gravities have been charted and rated in the usual fashion.

### *Loss Factor*

In considering the electrical insulation properties of materials, the first thing to investigate, since most current is alternating or intermittent, is the power that is absorbed by insulation in performing its function. This is termed "loss factor." In the table, the best material is given a loss factor of 1. The other materials are rated accordingly with numbers since there is not sufficient space to show them in a two-dimenisonal manner. Note that the general-purpose phenolic, which has been very satisfactory for thousands of uses for 60 cycles, 110 to 440 volt, has 10,000 times the loss factor of polystyrene. Loss factor becomes serious as the frequency increases. One specification set by radio engineers for insulation on short-wave transmitting equipment required that an insulating material, placed in the field of the transmitter at 30 million cycles, heat up not more than 10 deg. F. above room temperature. Polystyrene is the only plastic which has a chance of meeting that requirement.

Next in importance is resistivity. This relates principally to direct current use. All the materials shown have been satisfactory on direct current applications. Again polystyrene is considerably better than general-purpose phenolic. The ratio is surprisingly 10 million to 9.

In studying an insulating material, dielectric strength has been given more consideration than any other. Tests are made under controlled conditions at 60 cycles. Many parts are designed and plastics used for them considering only this one property. But the dielectric strength of all plastic materials is affected adversely by heat. Hence, if the loss factor is such as to cause heating and alternating or intermittent current is involved, the dielectric strength will be correspondingly reduced. The specifications of a molded spool required that the walls withstand 22,000 volts electrical pressure for a given period of time. Failure occurred. Finally, with a general-purpose type material a product was produced with a dielectric strength of over 500 volts per mil on an A.S.T.M. test piece. Still failure occurred. Taking loss factor into consideration, a product of a low loss factor with a dielectric strength of only 350 volts per mil was used successfully. Dielectric strength is also affected adversely as the thickness of the piece is increased.

In the table which summarizes this article, the materials have been rated numerically as an aid in determining which plastic would be best suited for certain requirements. There is also a column, "Moldability Around Inserts" which refers to the ability to mold a metal insert, anchor in firmly, and retain it without wall cracking.

As an example of the use of the table, consider the distributor head in an automobile. General-purpose phenolic material has been used satisfactorily for a number of years on this part. The main requirement of an automobile distributor head is moldability around inserts. Referring to the table we have four phenolic materials rated in the No. 1 position: general-purpose, low-loss, heat-resistant and shock-resistant.

The next property desired is insulation. The current that gives the spark on the plug is intermittent, and therefore, loss factor is important. On consideration of this column, two of the four materials drop out and general-purpose phenolic and low-loss phenolic remain.

For chemical resistance, low-loss phenolic is best suited. And for strength, resistivity and dielectric strength, it is still best. Indicative of this fact, one of the large automotive companies has recently stated that this material is the most satisfactory material they have yet tested for their ignition parts. However, there is another factor to consider, that of cost. The general-purpose phenolic is cheaper not only by the pound, but lower in specific gravity as indicated by the table, and can be molded more readily.

Incidentally, special general purpose materials have been developed that are improvements over the ratings recorded in the table. But the table is based on the average high value of a specific class of materials. The products that have been developed are considered specialties.

### *Selecting a Material*

As an additional example, consider a fountain pen barrel as a housing only and a fountain pen cap. The primary thing desired is toughness; cellulose acetate is No. 1. Under the column "Color," cellulose acetate is No. 2. The fountain pen must not freeze when the two parts are screwed together, so dimensional change on ageing must be considered. We run into a red flag—No. 8. Going backward, the second toughest material, shock-resistant phenolic, is rated poor on color. Further investigation of dimensional changes on the part involved will probably give a choice of cellulose acetate. It is used and found satisfactory.

However, there is another requirement. One recent fountain pen is of the plunger type where the barrel comes in direct contact with the ink; chemical resistance is involved. Therefore the manufacturers are experimenting with polystyrene, rated either No. 1 or No. 2 for water, acid, caustic and solvent resistance.

Thus far only a reference has been made to the all-important element of cost in a general way in using the table. When one considers the cost of a specific part,

many factors are involved. For example, *A* wishes to purchase 10,000 parts. He determines that cellulose acetate or general purpose phenolic would suit his needs. Which would be cheaper? If he states that he will purchase 10,000 only, the problem is simple, for, in general, molds for cellulose acetate parts are roughly forty per cent of the cost of molds for phenolics. This would also be true of molds for using polystyrene. On the other hand if customer *B* desired 5,000,000 bottle caps, the excess in mold cost is made up by the saving in material costs and he may well choose either phenolic or urea, for the material is sold by the pound at a relatively low price.

Parts produced of general-purpose phenolic materials are cheaper than those produced of urea. Polystyrene is more expensive by the pound or cubic inch than cellulose acetate, but in some instances production increase, using the polystyrene, has offset the differential in material cost. General-purpose phenolic is first in low cost. Heat-resistant phenolic second; urea third; low-loss fourth phenolic; acid- and alkali-resistant phenolic fifth and impact-resistant phenolic sixth.

### *Design Factors*

The first consideration for economic production is that a part must be removed from the mold. Hence avoid undercuts or side holes. It is inadvisable to allow less than 1 deg. Preferably, 3 deg. draft should be used for molded parts.

The next point to consider is the parting line or lines. In spite of literature that states plastic parts come from the mold requiring no further finishing, we regret to say that such is not the case. It is often necessary to remove fins by filing or sanding, and polish by hand, buffing to approximate the mold finish on the balance of the part. This operation is costly and sometimes necessitates the use of more expensive materials that are so colored as to eliminate the possibility of specks showing when the surface is cut.

Sharp corners should be avoided wherever possible, since to produce the sharp corners in a steel die is a difficult and expensive.

A part should have uniform wall thickness. Where a part is designed with nonuniform section, irregular shrinkage and difficulty of polymerization prevail, and it is almost impossible to cure the thick sections thoroughly. Redesign the part by coring so as to make the wall thickness uniform.

Inserts are widely used in molded plastics. With a threaded insert molded flush with the piece, material flows on the threads and it is necessary to clean them. The correct technique is to use round inserts protruding from the piece sufficiently to seat in the mold and reduce the tendency of the material to flow into the threads, thus eliminating an expensive cleaning operation. Thin walls around inserts and sharp corners increase the tendency to crack. Generally, a round insert permits sufficient wall thickness to eliminate cracking.

| | Phenolic: | | | | | Urea | Poly-styrene | Cellulose Acetate |
|---|---|---|---|---|---|---|---|---|
| | General Purpose | Low Loss | Heat Resistant | Acid & Alkali Resistant | Shock Resistant | | | |
| Toughness (Impact Strength) | 6 | 3 | 7 | 8 | 2 | 5 | 4 | 1 |
| Flexural Strength | 3 | 3 | 4 | 5 | 2 | 1 | 5 | 5 |
| Tensile Strength | 2 | 3 | 7 | 5 | 4 | 1 | 6 | 4 |
| Color | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 |
| Cold Flow | 4 | 2 | 1 | 6 | 5 | 3 | 7 | 8 |
| Dimensional Change on Aging | 4 | 2 | 1 | 5 | 6 | 7 | 3 | 8 |
| Heat Resistance | 2 | 3 | 1 | 3 | 3 | 6 | 4 | 5 |
| Flammability | 3 | 1 | 1 | 2 | 4 | 5 | 6 | 6 |
| Heat Insulation (Thermal Conductivity) | 3 | 6 | 6 | 2 | 2 | 5 | 1 | 4 |
| Weight per Unit Volume (Specific Gr.) | 3 | 6 | 7 | 2 | 4 | 5 | 1 | 3 |
| Hardness | 5 | 2 | 1 | 4 | 5 | 3 | 6 | 7 |
| Loss Factor (Range of Frequencies) | 5 | 2 | | | | 4 | 1 | 3 |
| Resistivity | 6 | 2 | 7 | 3 | 8 | 4 | 1 | 5 |
| Dielectric Strength | 4 | 3 | 5 | 4 | 5 | 1 | 2 | 4 |
| Moldability Around Inserts | 1 | 1 | 1 | 2 | 1 | 3 | 5 | 4 |
| Water Absorption | 5 | 2 | 2 | 3 | 6 | 4 | 1 | 7 |
| Acid Resistance | 3 | 3 | 4 | 2 | 4 | 4 | 1 | 4 |
| Caustic Resistance | 3 | 3 | 3 | 2 | 4 | 3 | 1 | 4 |
| Solvent Resistance | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |

### *Errors to Avoid*

Specify raised letters or decorations in plastic pieces; it is only necessary then to engrave them in the mold, whereas if they are sunk in the molded piece it will require excessive die machining.

Avoid holes or inserts that require long, slender core pins to hold them in place during the molding operation. Bear in mind that the plastic flows under pressure from 2,000 to 6,500 lb. per sq.in. and these pins will break if they are too long or too small in diameter.

Don't design parts with re-entrant curves or undercuts; or call for blind holes or inserts in the sides of pieces where the depth of the hole or the length of the insert is greater than twice its breadth; or call for blind holes or inserts in the sides of pieces where the depth of the hole or the length of the insert is greater than twice its breadth; or call for unnecessarily close tolerances.

In designing molded parts for electric service make sure that the arc will break in the air against a sharp corner of a metal insert, rather than against the plastic. For example, the jump gap type of distributor head is preferable to the wiping contact type. If wiping contact is essential, do not use the materials discussed in this article.

### *Checking Design with Models*

After arriving at a design that looks satisfactory both to yourself and the molder, have a wooden model built, and study the model. It is possible changes will be necessary that could not be seen in the blueprint. This is particularly true where convex and concave surfaces are involved, requiring an assembly of irregularly shaped pieces, as is encountered in an electric razor housing.

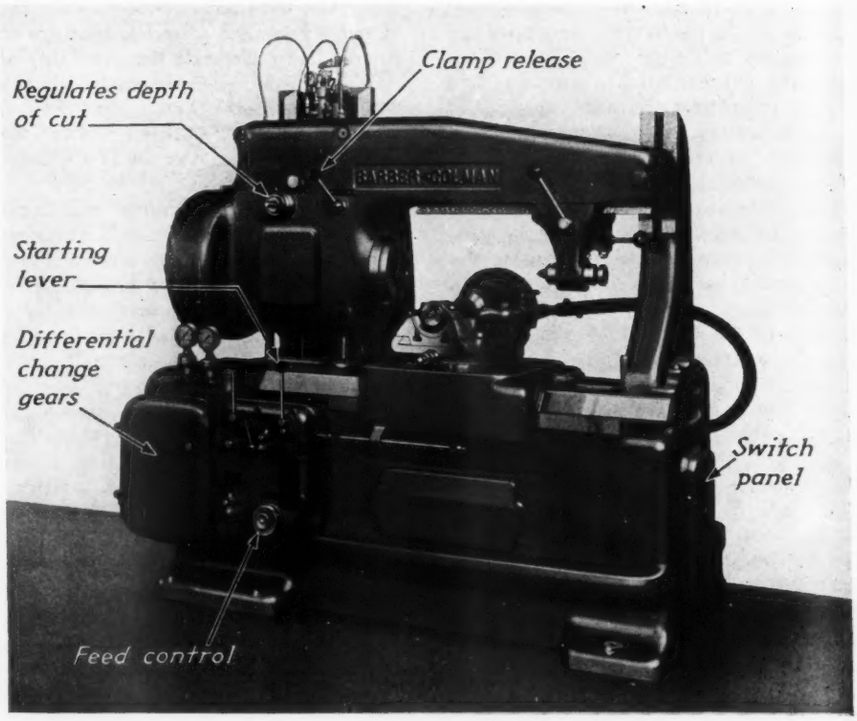
Take for example the problem of electric razor housings. Two companies, *A* and *B*, recently decided to proceed in the manufacture of a razor. One designed the parts, proceeded to place the order without consulting the molder and insisted that tools and production should be rushed as fast as possible. The second, *B*, proceeded differently: he asked for suggestions and received them and built a model at a cost of $56. It disclosed bad parting lines, which were rectified; it also disclosed insufficient clearance for the coil. The model was patched and the housing was redesigned, employing radii where possible. The model showed necessary design changes to promote economical mold construction, and the mold bid was reduced.

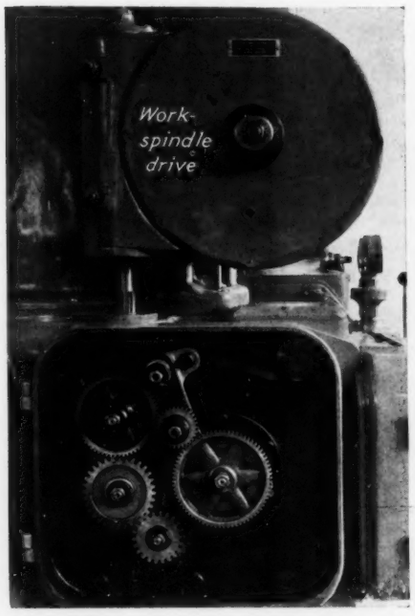
# Modern Designs

## Hydraulic System Controls Operation Cycle

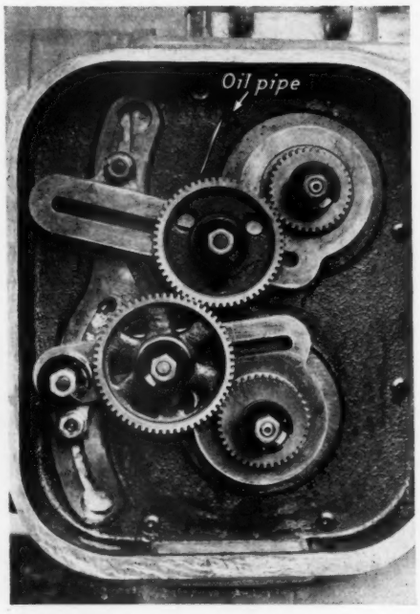
GEAR HOBBING cycle on this Barber-Colman machine is controlled automatically by a compact hydraulic system designed to fit in a casting in rear of control panel. In operation, work slide descends to cutting position where it is held by five hydraulic clamps. Main drive clutch is then actuated hydraulically, starting the machine and engaging the feed. Upon completing cut the drive clutch is disengaged, thereby stopping hob, work spindle and coolant pump. Work slide is then released and raised so that hob clears work, and hob slide is then returned to original position as determined by collars on stop rod. Valves are provided to permit both conventional cutting and climb cutting.

Work spindle slide, over-arm and index worm gear case are one casting which is raised and lowered positively to upper or lower position by hydraulic cylinder in the base and which is held in position by four hydraulic clamps on the double V-ways on upright and one clamp on the end brace casting. Hydraulic pistons actuate roller bearing wedges to tighten draw bolts.

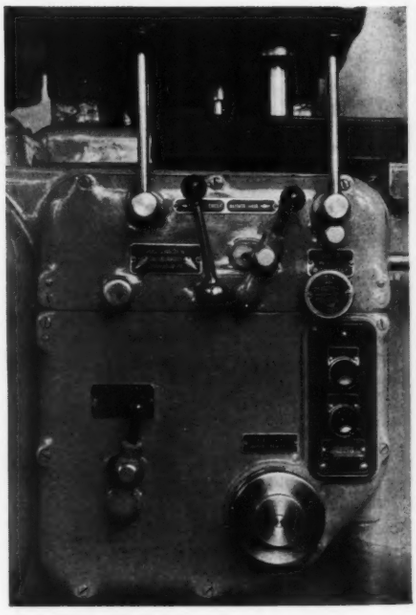


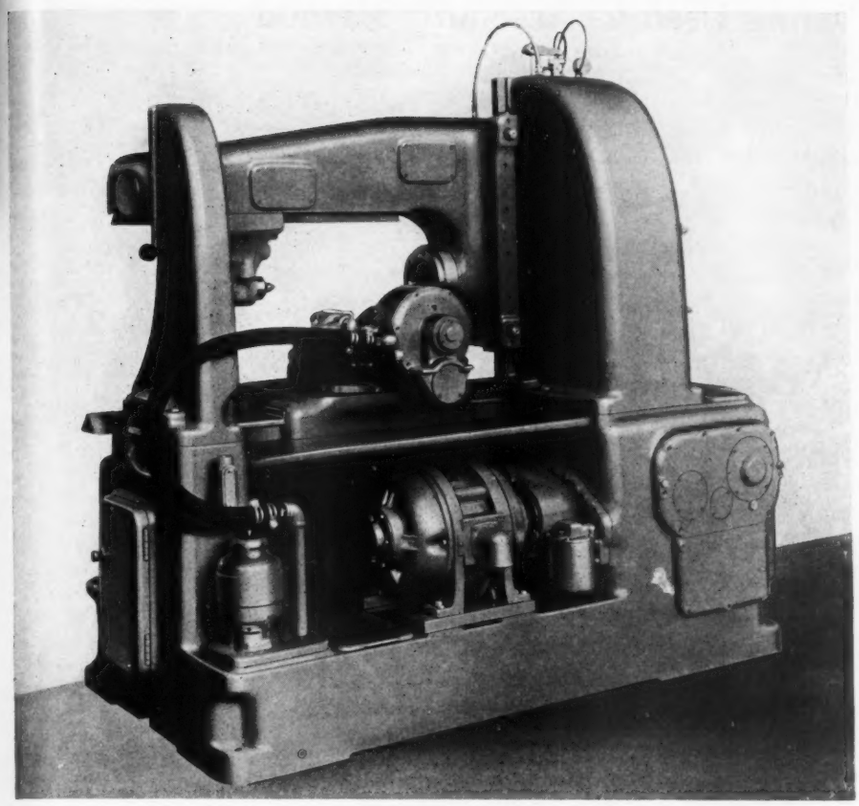

**Oil tight compartment** houses index gear train and pick-off gears for changing hob spindle speeds. Work spindle is driven through large-diameter worm gear. Mating worm, hardened and ground, runs on anti-friction bearings.




**Differential and change** gears placed at front of machine transmit the power from main drive shaft to splined hob drive shaft. When cutting spur gears or non-spiral forms, the differential spider is locked.



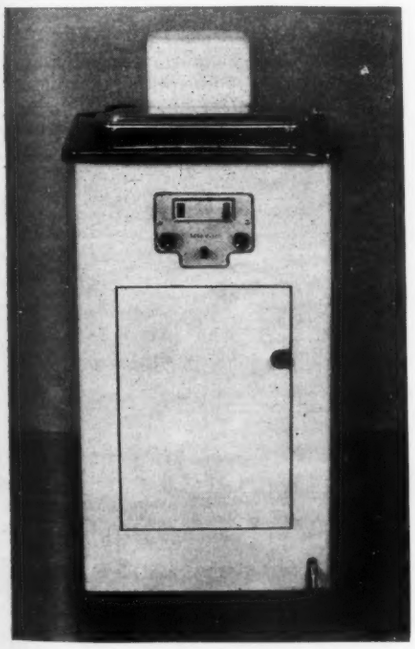
**Hydraulic control** includes a variable displacement high pressure pump direct driven through a flexible coupling from the electric motor. Feed is driven by a constant displacement hydraulic motor which operates off the same pump.



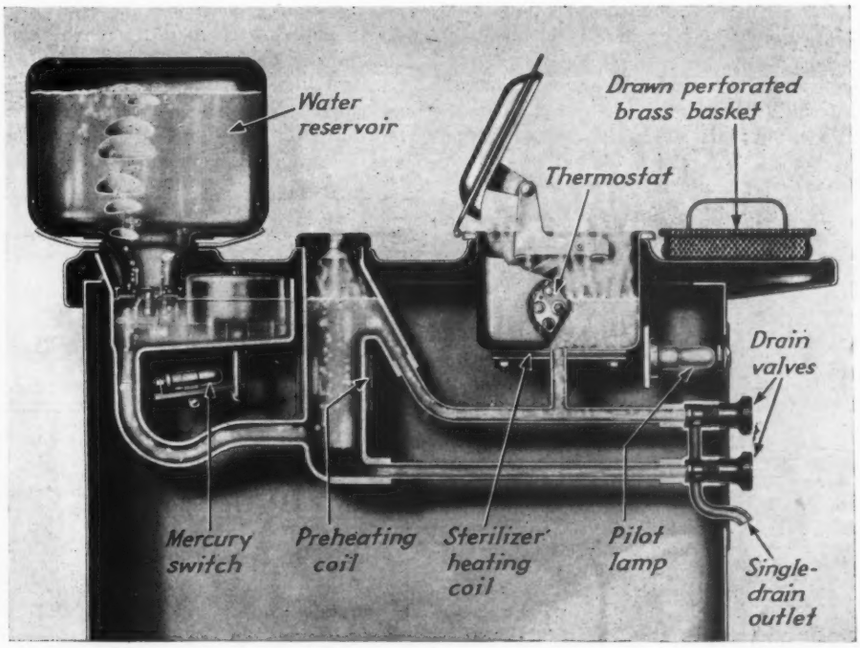
**Standard hob spindle** is mounted on three tapered sleeve bearings in the slide assembly, the end adjustment being made by rotating a pinion meshing with the teeth cut in the periphery of the adjusting nut.

**Ten hp. motor** controlled by push-button station on the front of the machine, is mounted on the rear of the base casting and direct-connected through a flexible coupling to a pinion shaft driving the hydraulic pump, the automatic lubricator and the helical ring gear which is mounted on the main drive clutch.

## Ritter Hydromatic Sterilizer

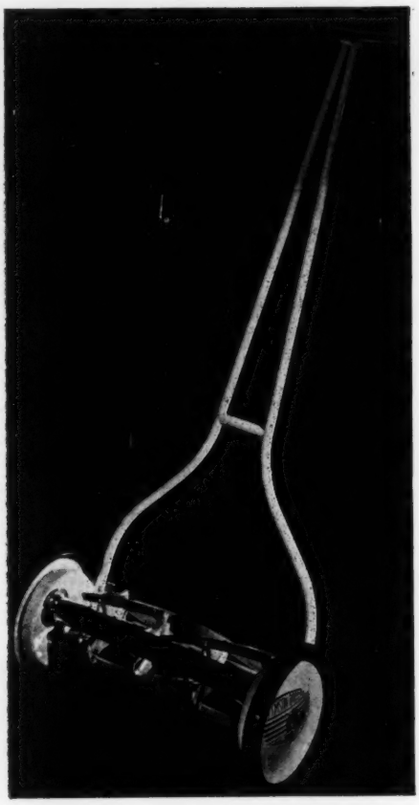


**One source of trouble** and annoyance in operating dental sterilizing equipment is the necessity for constant observation and refilling of the sterilizing tank to maintain proper water level. In the Ritter Dental Company's new sterilizer, automatic water level maintenance is provided by an oversize reservoir and float-type control of the heating coil.

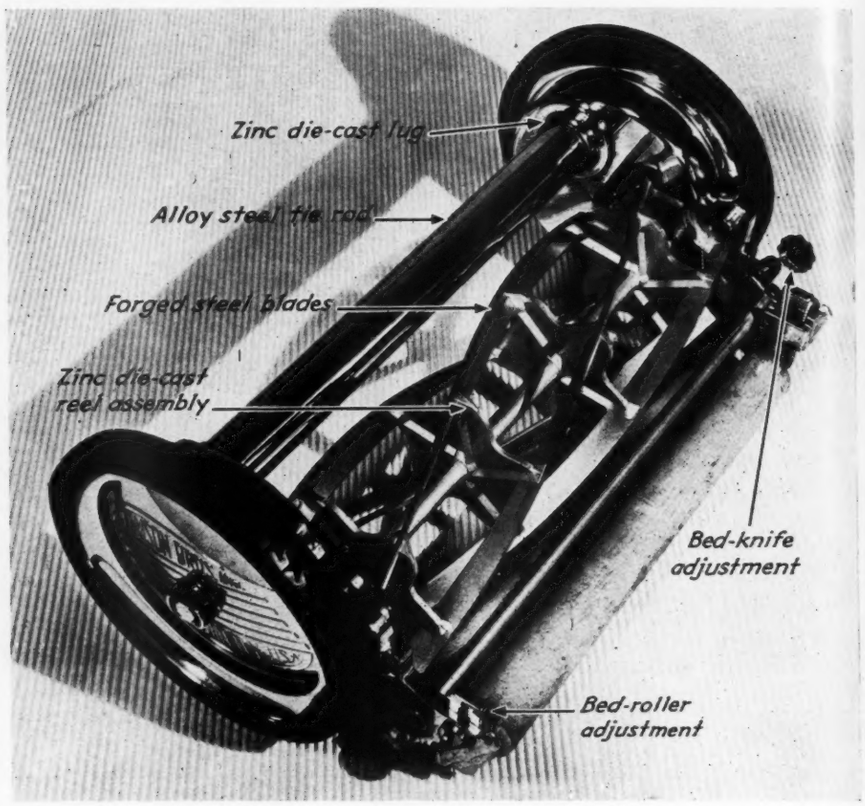



**Diagrammatic view** of the sterilizer assembly shows the location of the protective devices and the method of supplying pre-heated water to the seamless, drawn-brass sterilizing tank. A large size heating coil, governed by a Westinghouse thermostat, maintains the water at sterilizing temperature; and a pilot light, operating in conjunction with the safety switch, signals when water is needed. Dual drain valves of large diameter for free flow are molded of Bakelite. One drains the pre-sterilizer line, the other the sterilizing tank. Cabinet is drawn sheet steel, lacquered, and base and top are porcelain enamel finished. All exposed polished parts are chrome finished. Sterilizer is available in six colors.

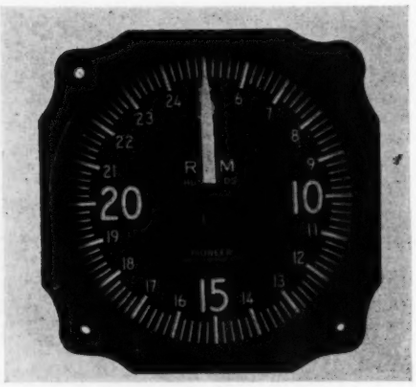
# *Modern Designs*—Die Casting Used as Assembly Method



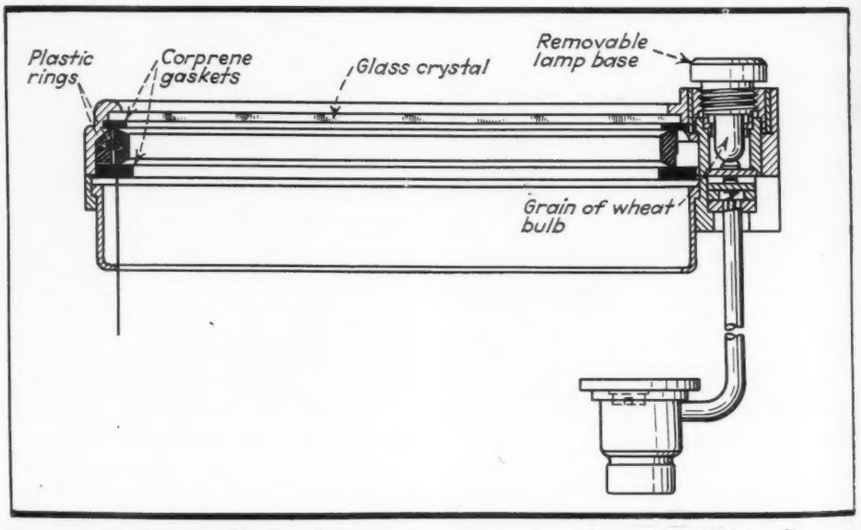
**In the Clemson lawn mower,** die-castings are used in assembling the steel parts. The four spiders that hold the blades are integrally die-cast around the blades and shaft, so that the entire reel and fly-knife assembly is one rigid piece, and no strains are imposed on the blades. Blades in this assembly are of high-carbon steel, forged to shape.




**Bed knife,** of high-carbon alloy steel, bent to shape, welded and heat-treated, is of one-piece construction. Thus it is stiffer and lighter than the usual construction of an iron shoe with a bolted-on steel blade. A single knurled knob-adjustment for blade wear is provided, moving both sides of blade in unison and continued alignment. Wheels are equipped with roller bearings, and the fly-knife shaft, of hollow steel, runs on double-sealed precision ball bearings. The tie-tube, of carbon steel, which maintains the two gear housings in alignment, locks into special lugs integrally die-cast in the gear housings. Mower handle, wheels and gear housings are finished in baked yellow enamel, chrome-trimmed.



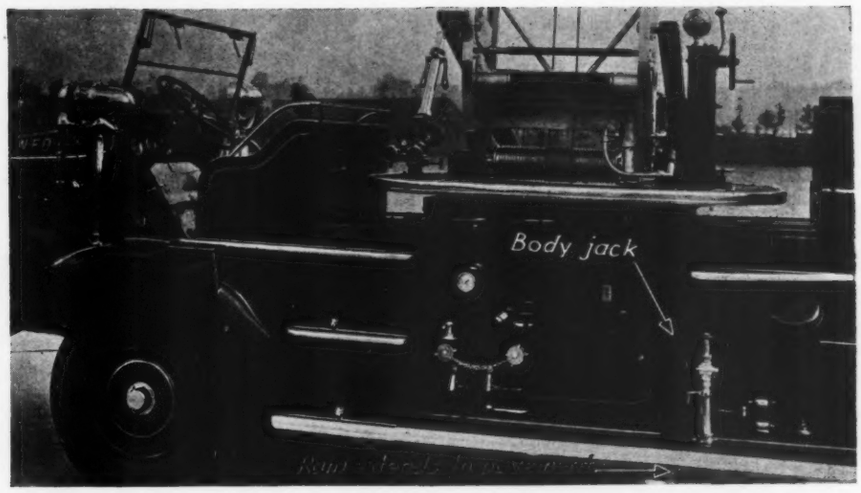

**Uniform and non-glaring illumination** over a circular instrument dial has been achieved by the Pioneer Instrument Company by use of two injection-molded rings of transparent poly-styrol or acrylic plastics. The rings circle the instrument dial but are hidden from view. Light travels through the rings in both directions, much of it being deflected through the side walls.



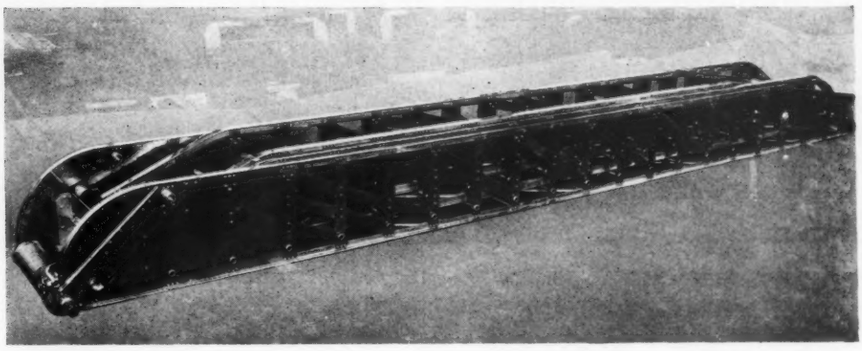

**Two injection-molded rings** are placed in concentric position around the dial and in a recess of the die-cast aluminum bezel. The recess is painted white, but the remainder of the bezel is black, except for a light well of ¼-in. diameter which incloses the small lamp. The latter is fitted into a brass screw cap and is removable from the front of the instrument without disturbing any wiring.

# Duralumin Ladder Hydraulically Controlled

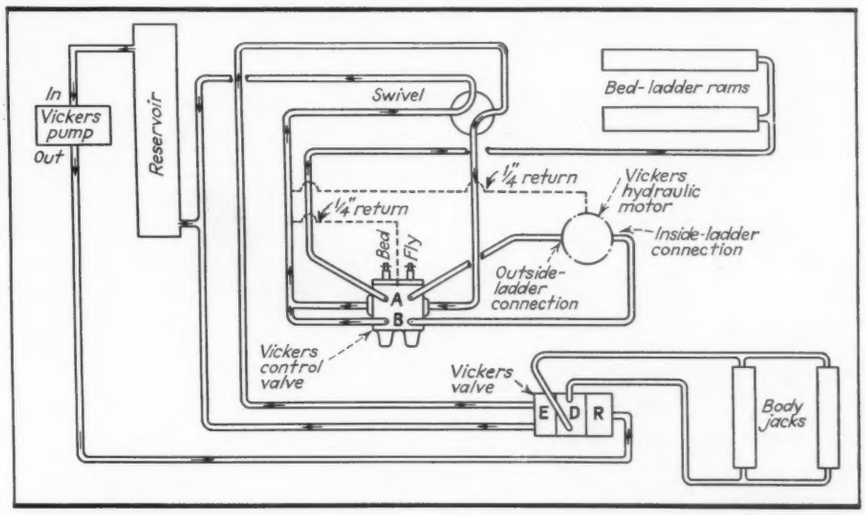
**Four-wheel drive** truck for fire fighting service, built by the Walter Motor Truck Company, is equipped with a hydraulically controlled 75-ft. extension ladder built almost entirely of duralumin. Truck is powered by a 150 hp. motor. Relatively short wheelbase permits easy maneuvering in crowded areas. A special form of automatic or torque proportioning differential transmits power to all four wheels, thereby making operation substantially independent of weather and tractive conditions. The mechanical design features of this Walter truck will be further described and illustrated in a later number of *Product Engineering*.




**Platform** is provided with hydraulic body jacks, the rams of which, when extended to the pavement, form outrigger braces that prevent tilting of the truck. Operation of these body jacks causes automatic application of the hand brakes on the truck wheels. A pair of hydraulic rams raise and lower the ladder.

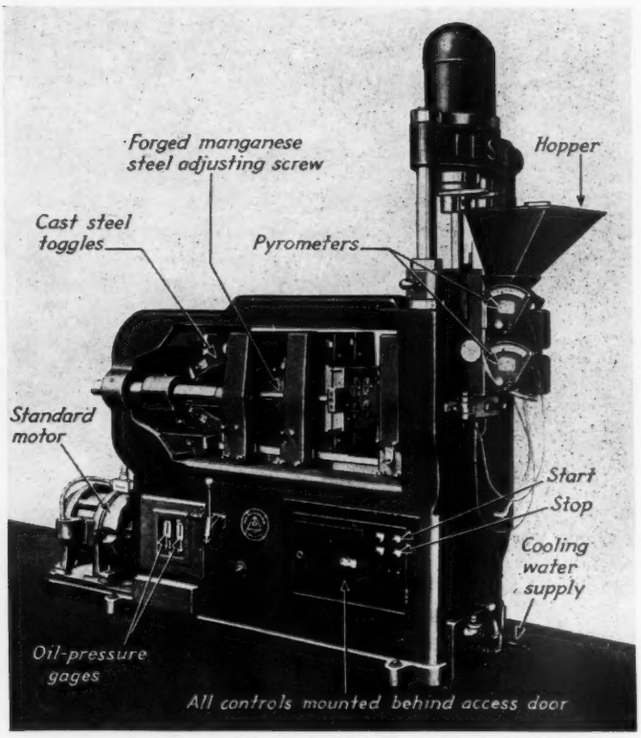


**Duralumin** is used for the ladder to obtain a high strength-weight ratio. Unusual truss-type construction employs flat and rolled sections. Tubular rings for rungs contribute to ladder stiffness. X-type bracing, of tubing flattened at the ends and bolted to the side rails, prevents twisting of the ladder when loaded.

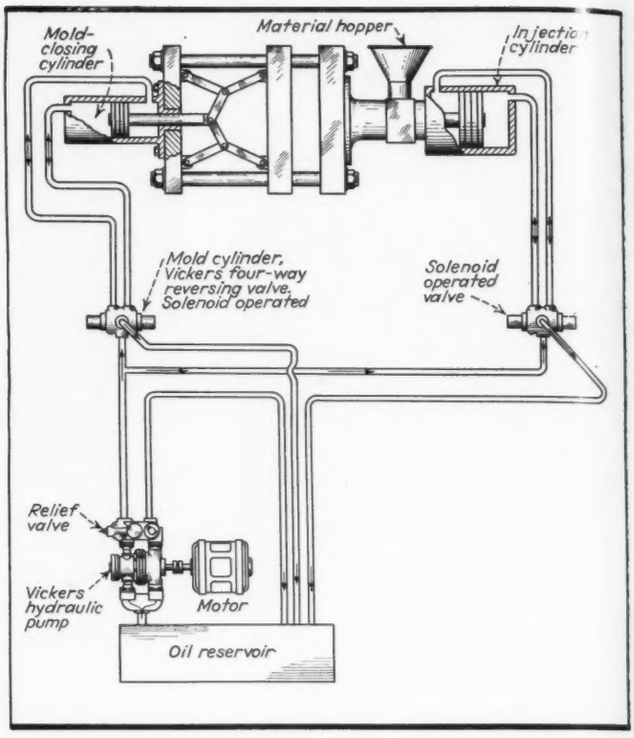



**Hydraulic ladder lift** is powered by a Vickers vane-type pump which can maintain 1000 lb. per sq. in. pressure. The twin ladder rams have three-foot stroke. A single lever controls a safety valve at each ram to hold and lock ladder in any desired position. Fly ladders are extended and lowered by a stainless steel cable, wound on a drum which is worm-driven from a special hydraulic motor.

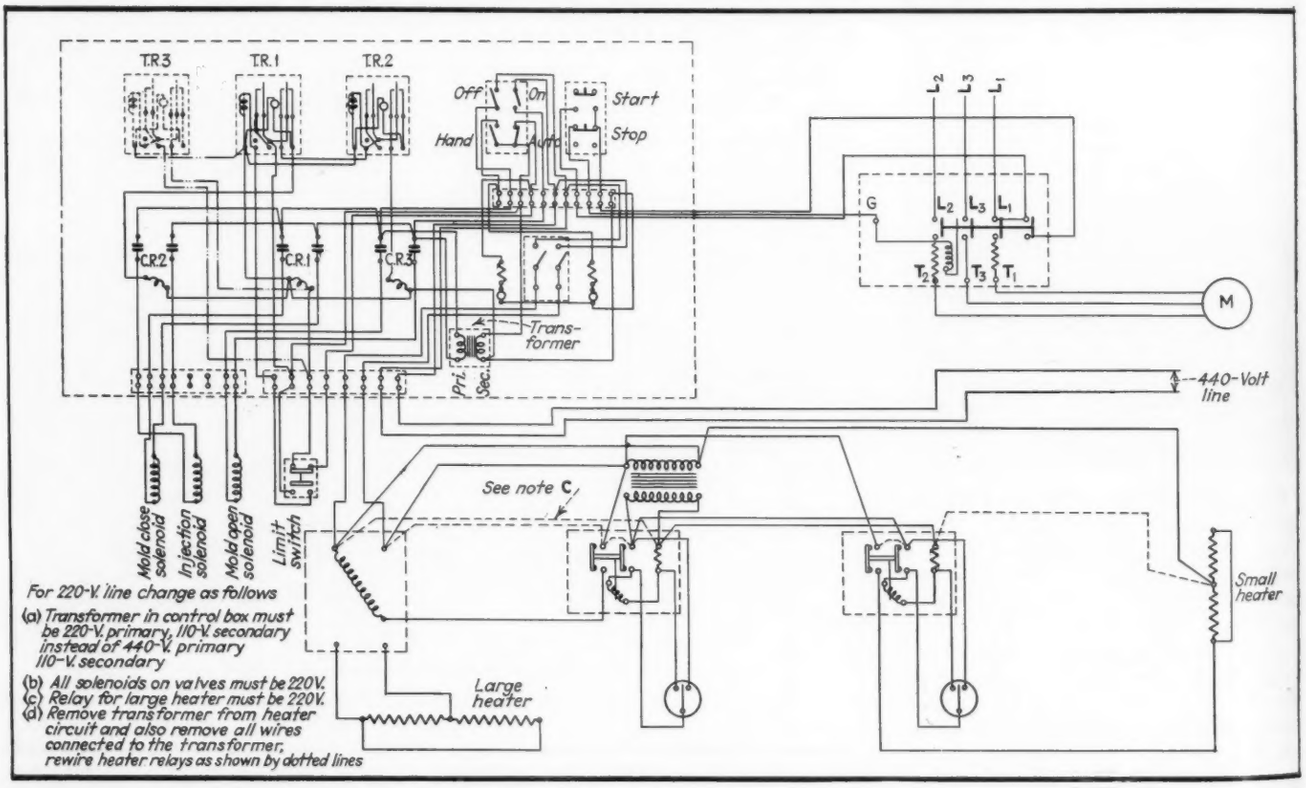
# *Modern Designs*—Full-Automatic Injection Molding Machine



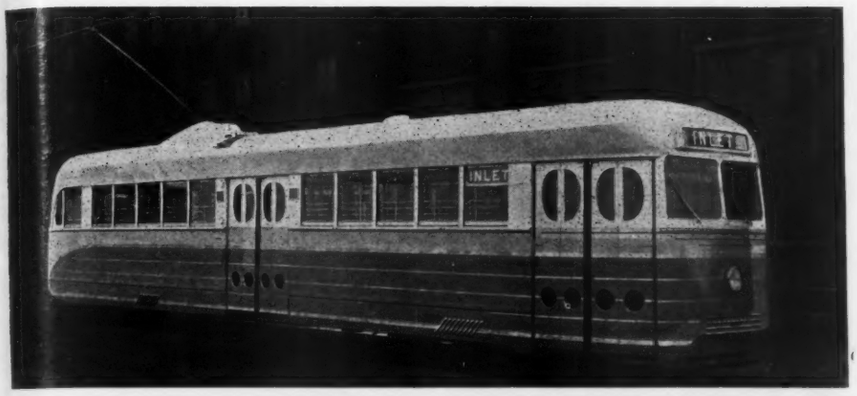

**Three timing switches** automatically control all operations in this Index injection machine, designed by the Lester Engineering Company, built in 4, 6 and 8 oz. capacities and driven by a 10, 15 or 20 hp. polyphase motor, depending on capacity.

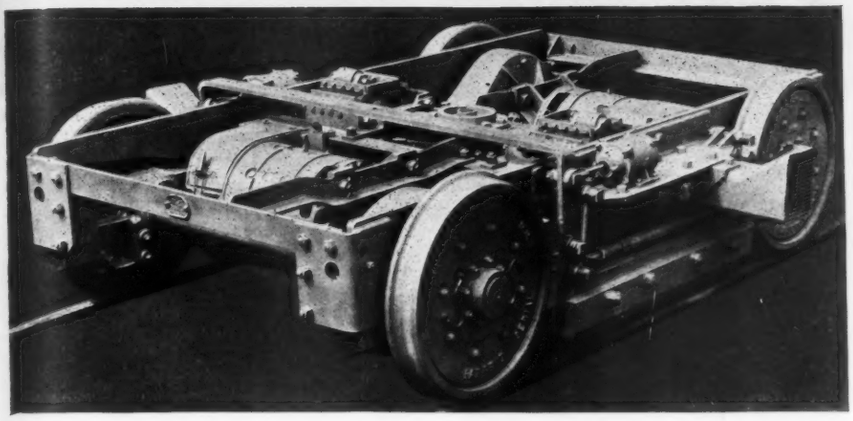



**Hydraulic circuit** which operates the injection plunger and the mold closing plunger—toggle mechanism. When the mold closes, the cam faces on the toggle links engage. Entire locking pressure is taken off toggle pins, is transmitted through cams.



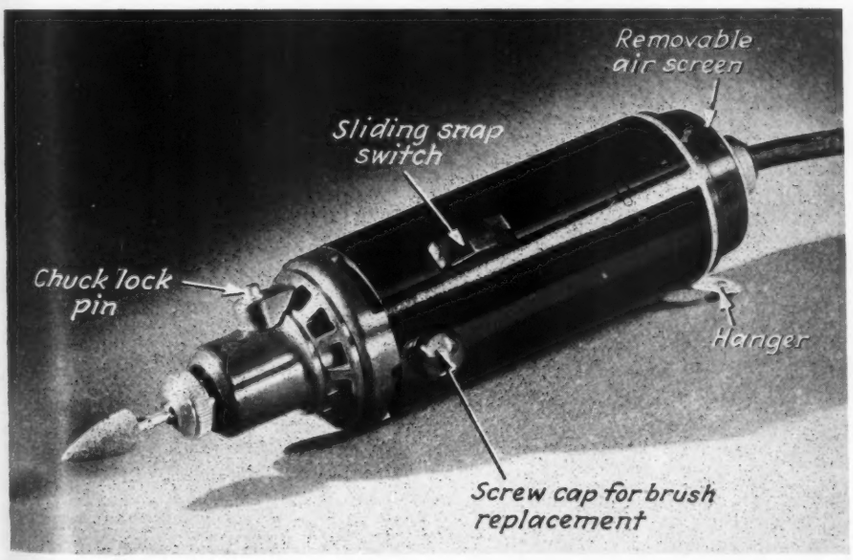

**Electric control circuit** is interlocked with the hydraulic circuit. Control assembly, consisting of timers, relays and contractors is recessed in the machine base. Two automatic thermostatic controls maintain proper temperature of the plastic material in the injection cylinder. The machine may be operated automatic or semi-automatic; for semi-automatic operation, only one lever is manipulated. A mechanical-driven knockout removes the finished pieces.



**Four 300-volt motors** of 55 hp. each, which operate two-in-series on 600 volts, drive the newly designed Brilliner, a high speed streamlined car, built by J. G. Brill Company and styled by Raymond Loewy. A motor-generator set furnishes low voltage current for the power control circuit track brakes, pneumatic door engines and automatically charges the storage-battery. There are three braking systems—dynamic, magnetic track brakes and air brakes. Motors are spring-suspended within truck wheelbase and connected by universal joints to the single-reduction drive unit, equipped with helical gears. Weight of carbody is cushioned by four double rubber pads, working in shear, which support the bolster. Additional rubber cushions are located at the four corners.

**Multi-Miller,** designed by the U. S. Tool Company, is furnished with a built-in pressure oiling system which provides metered lubrication to the various moving parts. The spindle is made of S.A.E. 3135 steel, heat-treated and ground; it is mounted in anti-friction bearings. Spindle is driven by double V-belts directly from the motor which is mounted on a hinged bracket. Table is rack driven by a cam operating sector. A cabinet type base houses the driving units and electrical equipment, and a 10-gal. tank is provided for the coolant.




**Midget Moto-Tool,** 13 oz. in weight, 6⅝ in. long and 1 1/16 in. in diameter, is powered by a 60-watt universal motor operating at 27,000 r.p.m. Built by the Dremel Manufacturing Company, the tool is fully inclosed in a Bakelite housing, with a built-in sliding snap-switch. Screw caps permit easy replacement of commutator brushes. Motor shaft is hardened and ground.

## RANDOM JOTTINGS ABOUT NEW DEVELOPMENTS

American Bantam Company has designed a new series of Bantam autos including in the line a new commercial unit known as the Boulevard Delivery. The Bantam is about 120 in. long and has a 4-cylinder, 20 hp. engine.

* * *

A combination monel sink, automatic dishwasher and automatic clothes washer has been developed as a compact cabinet unit for household use.

* * *

The take-up reel which was recently a feature of the Cordomatic vacuum cleaner, is now available to all vacuum cleaner manufacturers. With a counterbalance the reel can be used to hold within easy reach of operator soldering irons, electric drills and other industrial appliances.

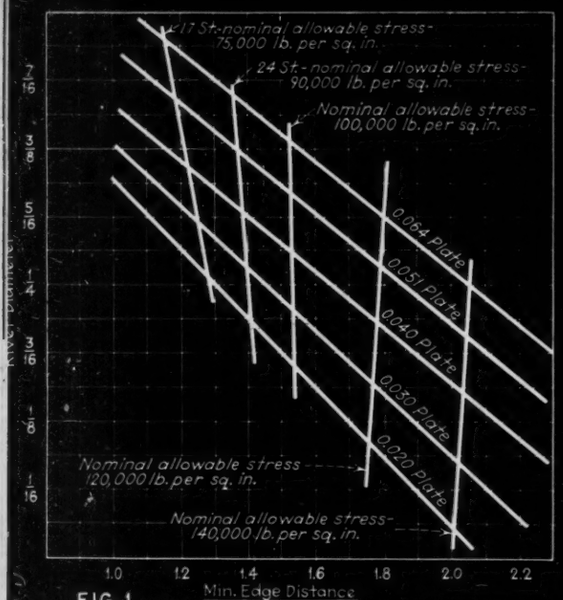



FIG. 1

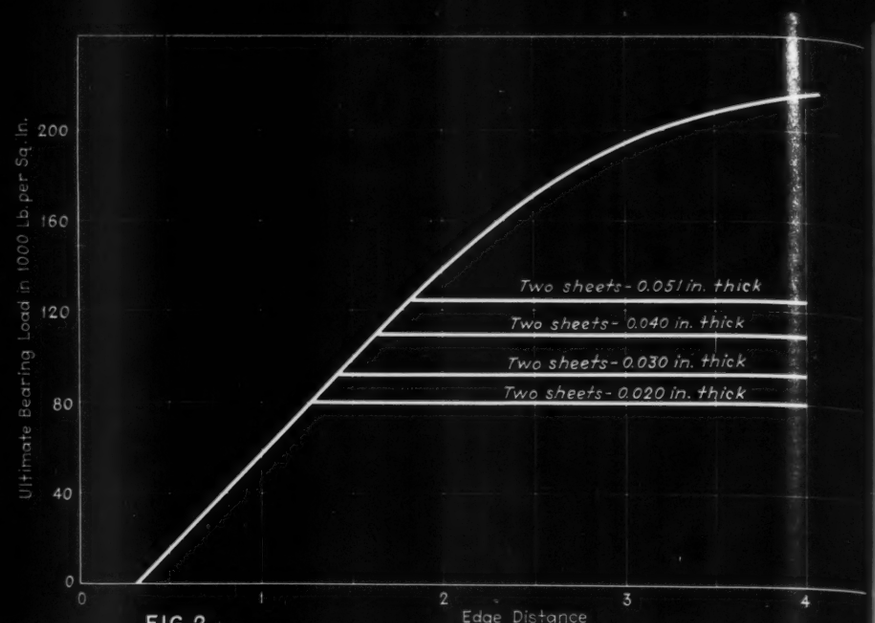



FIG. 2

# ALUMINUM ALLOY JOINTS

## *Edge Distance and Allowable Bearing Stresses*

T. C. BENNETT and R. P. FERNSLER

**An analysis of recently reported data on allowable bearing values for riveted or bolted joints in thin plate which takes into account the deformation of plate around the hole**

ONE OF THE common and sometimes difficult problems, particularly in aircraft design, is that of a riveted or bolted connection in aluminum alloy plate. The Aluminum Company of America states (Ref. 2) that the bearing strength of aluminum alloy plate in contact with a driven rivet is, for a 2-diameters edge distance, about 1.8 times the tensile strength of the plate. This factor reduces to approximately 1.35 for 1½ diameters edge distance, which figure corresponds roughly to the specified values for bearing strength given in tables, namely, 75,000 lb. per sq.in. for 17ST and 90,000 lb. per sq.in. for 24ST aluminum alloy.

Some independent tests of joints have been made (See Ref. 1, 2 and 3) to obtain values for allowable design stresses and edge distances. The curves in Fig. 1, plotted from test data (Ref. 1) show that to develop the 90,000 lb. per sq.in. bearing strength of 24ST material the minimum permissible edge distance is about 1.4 and for the 75,000 lb. per sq.in. bearing strength of 17ST is about 1.3 diameters.

It is interesting to note that both Pleines and Miller followed much the same test procedure and concerned themselves mainly with the load at which complete failure of the joint occurred. The method of test was to pull riveted samples until failure occurred by the sheet pulling out, tearing out, or shearing. The fundamental weakness of this method lies in the basic definition of bearing strength. Permanent distortion of the hole can, and undoubtedly does occur, long before the fracture of the test specimen.

It is evident that such a test fails to take into account the mechanism of the failure. By building up a pressure ridge in front of the hole, an increase in bearing area is obtained. If the edge distance is great enough, this tends to delay the ultimate failure of the specimen.

### *Plate Deformation*

Pleines noted the pronounced deformation and the thickening of the plate at the edge of the hole where it is most heavily stressed by the pressure exerted by the body of the rivet. The thickening is greatest at the edge of the hole, thus materially increasing the bearing area between the rivet and the plate and thereby reducing the unit crushing pressure. Measured thickness of the bulge varies from almost three times the plate thickness for a plate 0.012 in. thick to 1¼ times the thickness for a plate 0.158 in. thick.

The values of maximum unit bearing pressures indicated in Fig. 1 may be regarded as excessive since they represent the ratio of ultimate test load to original projected bearing area, or P/td. This is evident from the curve in Fig. 2 replotted from the original data, which shows the allowable ultimate bearing load still increasing at edge distances of four diameters, beyond which the tests were not carried.

For the thinner sheets a somewhat different explanation is required, since the curve of Fig. 2 shows that the allowable bearing strength of the thinner sheets is independent of the edge distance. Failure in thin sheets occurs by a rolling over of the sheet at the edge of the hole, followed by a progressive tearing of the sheet. The load required to tear the sheet is substantially constant and independent of edge distances if the minimum edge distance is not less than about 1 1/3 rived diameter. From a study of the results of all these tests it may be concluded that the bearing values so obtained are applicable to design only for static tension loads where subsequent

looseness of the rivet is of no importance and where vibration does not exist. It may be concluded further that, because of the type of failure, it is impossible to utilize in normal design the higher values shown by the generalized curve. Also, regardless of rivet size or plate thickness the edge distance required to develop a stress corresponding to the 90,000 lb. per sq.in. value for 24ST is approximately 1.4 diameters.

### *Test Results*

The method used by Miller provides no data on the loads at which permanent deformation first occurred. That the deformation occurs before the ultimate strength is reached is evident from independent sources, chiefly Hilbes (Ref. 2) who noted that small permanent deformation appeared in a riveted joint even under low stresses, and Pleines (Ref. 3) who remarked that the outstanding fact of all his tests was the enlarged hole at failure. The enlargement was of the magnitude of 15 to 70 per cent of the original hole diameter.

The Aluminum Company also states (Ref. 4) that permanent distortion of the rivet or bolt hole will occur when the material is stressed in bearing up to the numerical value of the ultimate tensile strength and that this value is independent of edge distance. Whenever no movement at the joint is desirable the use of this rule would require a maximum allowable bearing stress of 62,000 lb. per sq.in. compared to the 90,000 lb. per sq.in. specified.

That the latter figure is too great for certain design is indicated by tests such as the following. A ⅛-in. 24ST plate with a ⅝-in. pin was loaded in tension to 5,000 lb. The permanent deformation under this load was about 0.045 in. Yet, the edge distance was 1.4 diameters which, according to Fig. 1, indicates an allowable stress of 90,000 lb. per sq.in. and an allowable load of 7,000 lb., giving a margin of about 40 per cent. The load at which deformation first became of serious magnitude was not measured in this test since no such failure was anticipated, but it was at some load less than 5,000 lb. which is considerably less than the 7,000 lb. indicated by the maximum allowable stress.

Such data and experience seem to warrant a reduction in the allowable bearing stress wherever the permanent deformation of riveted, pinned or bolted joints must be avoided. Until future data are available the most reasonable value for design purposes appears to be the ultimate tensile strength.

In Figs. 3 and 4 the allowable bearing load based on the ultimate tensile strength, for common rivet sizes, has been plotted against plate thickness. The dotted curves represent the strength in shear of 17ST and 24ST rivets or 24ST sheets and steel bolts. The intersections of the solid lines that indicate bearing strength with the dotted curves represent the so-called most efficient joint, that is, where the nominal shear and bearing values are equal. To the right of these lines failure will occur as shear in the rivet. To the left of these lines the plate will fall first in bearing.

### *Recommendations*

In the light of present experience and information it appears reasonable to regard as good practice the use of:

1. Nominal edge distance of two diameters with a minimum permissible edge distance of 1½ diameters. This appears rather generous but it imposes in the majority of cases no particular hardship on the design and adds somewhat to the ability of a joint to avoid complete rupture in event of an overload.

2. Allowable bearing values taken from Fig. 2 or 3, which are based on values numerically equal to the ultimate tensile strength of the plate. It should be emphasized that the values shown on Figs. 2 and 3 are for the basic material only and in addition to any factor which may be required for a particular application in design.

REFERENCES

1. Roy A. Miller. "The Bearing Strength of Steel and Aluminum Alloy Sheet in Riveted or Bolted Joints," Journal of the Aeronautical Sciences, November, 1937.

2. W. Hilbes. "Riveted Joints in Thin Plates." NACA Technical Memorandum 590.

3. Wilhelm Pleines, "Riveting in Metal Aircraft Construction," NACA Technical Memorandums 596–599, inclusive.

4. Aluminum Company Bulletin—"Rivetting in Aluminum Alloy."

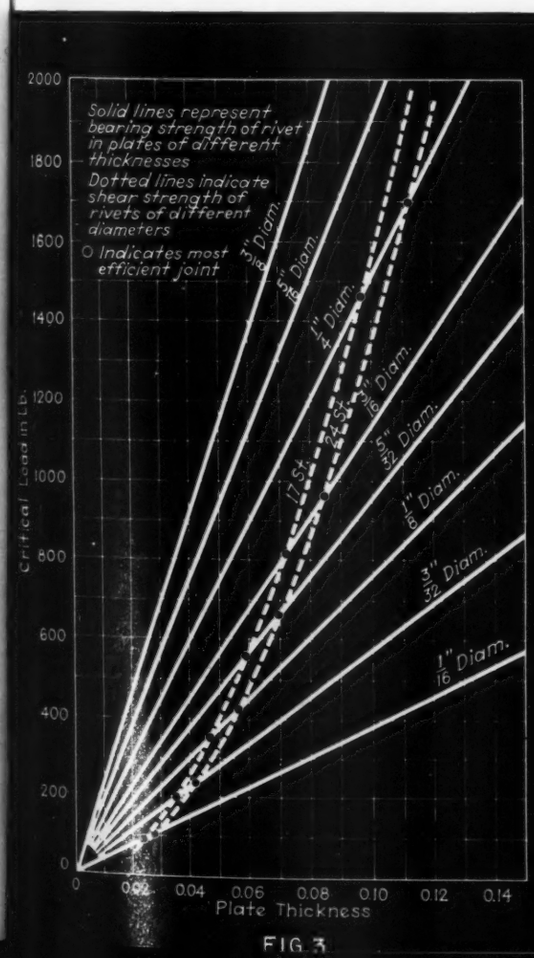



FIG. 3

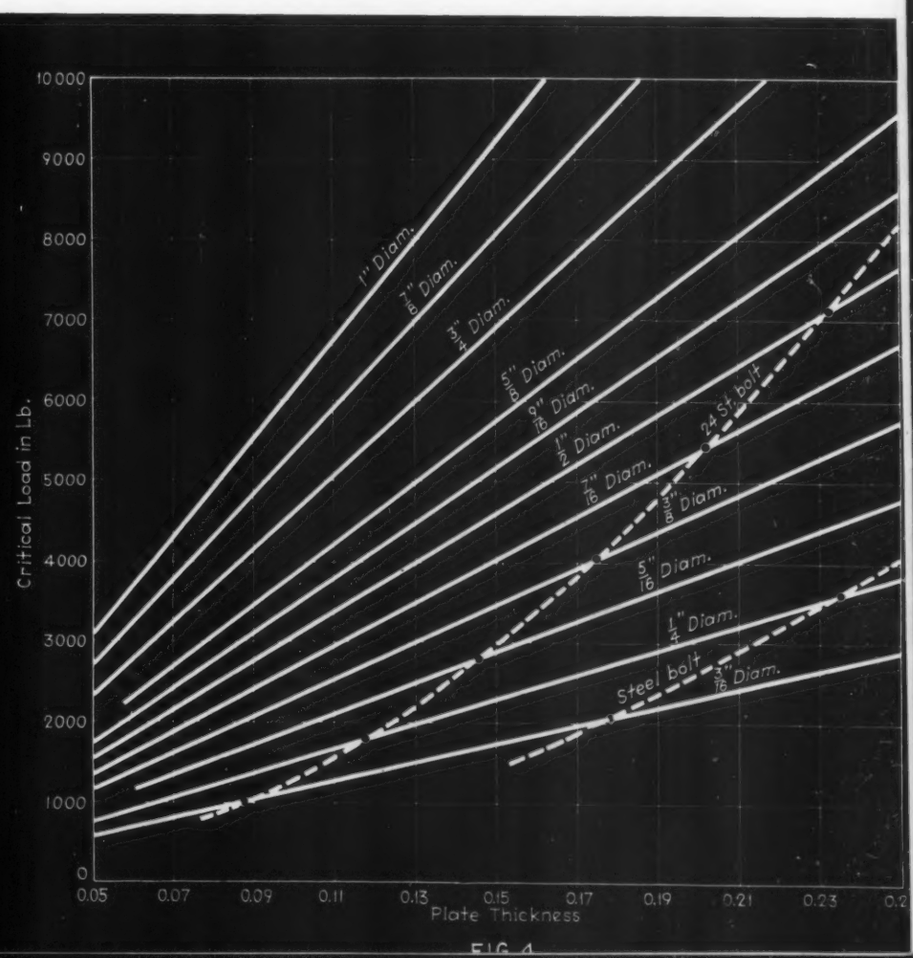
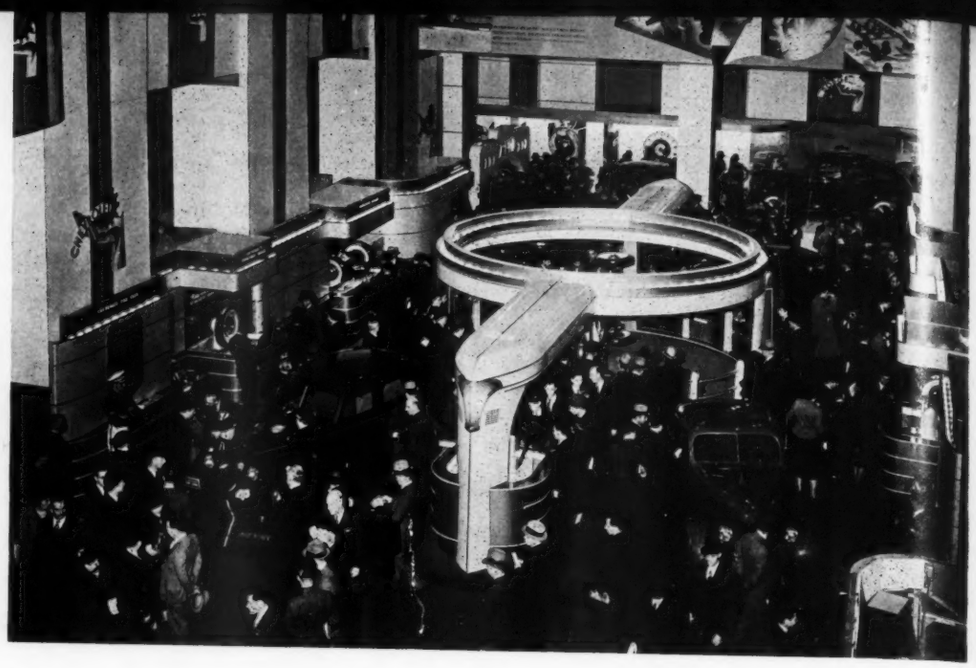
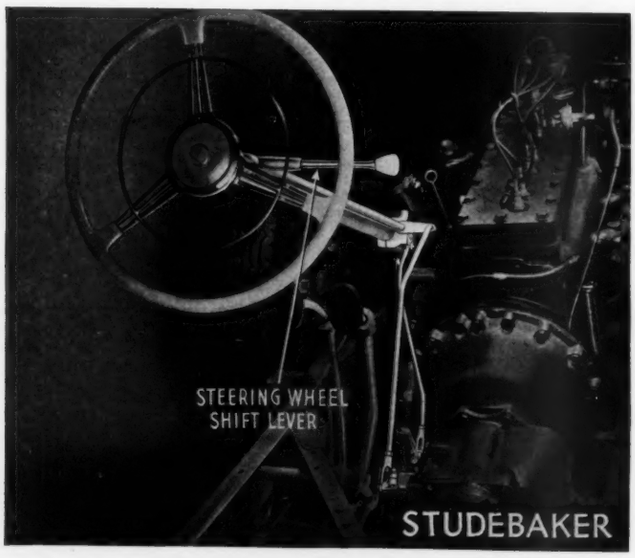


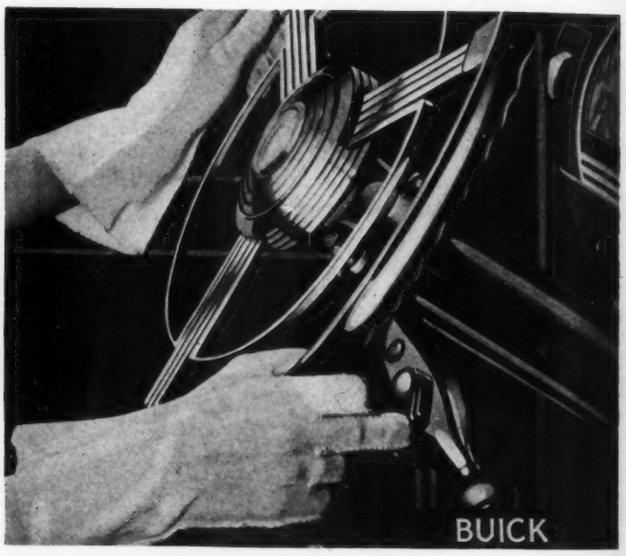

FIG. 4

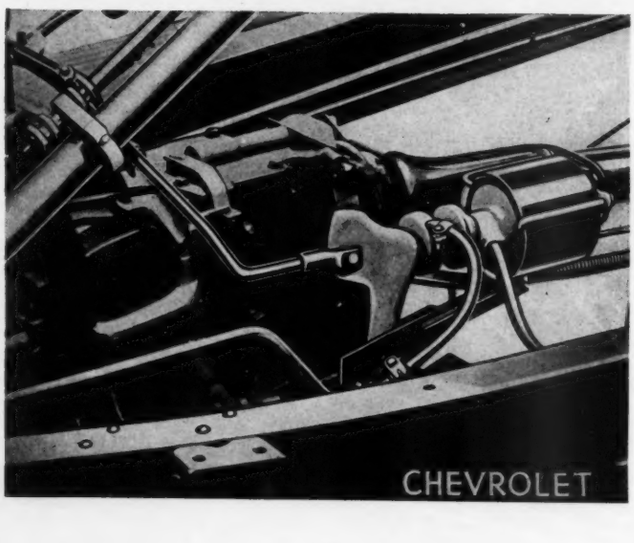


*View of the 1938 National Automobile Show at Grand Central Palace in New York. Most of the exhibits included cut away chassis and engine displays*

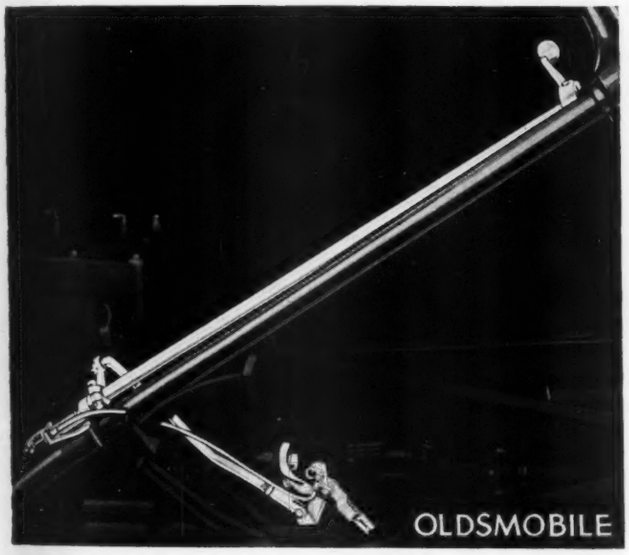
# DESIGN DETAILS of 1939 MODELS



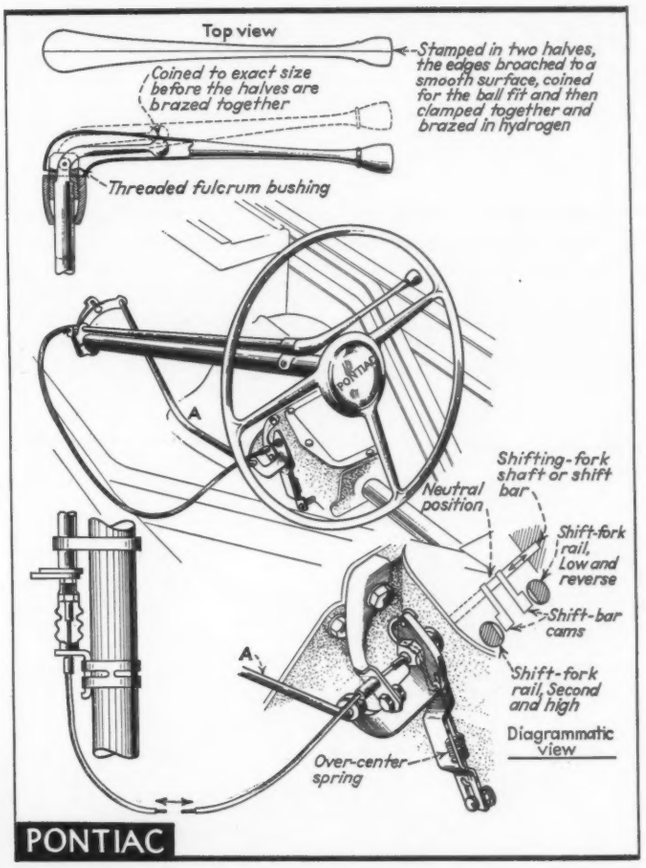



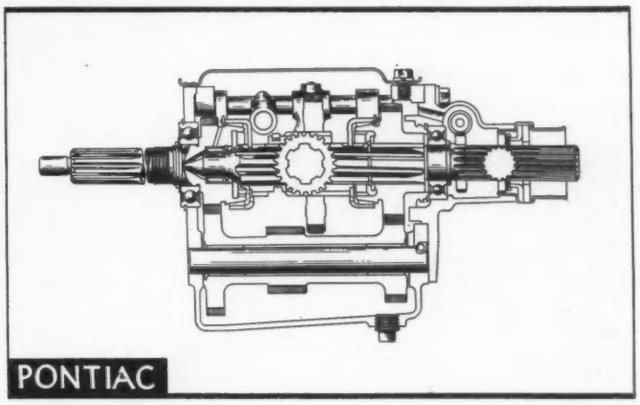



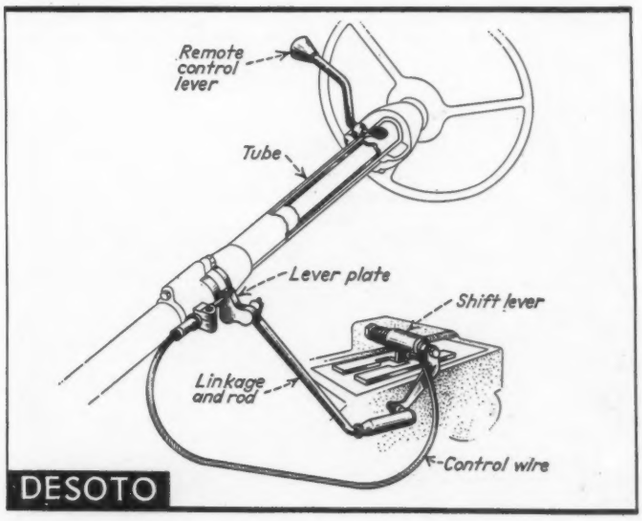
Various gear shift mechanisms with lever at steering wheel, magnetic control of over-drive throw-out, layouts of steering assemblies, and details of numerous other developments in the 1939 automobiles are illustrated and described in this article. Descriptions of exterior and interior styling, body arrangements and equipment have been covered in the daily press and automotive publications. This review, therefore, will be confined to engineering details of new developments, comparing the different ways in which the same engineering problem was handled by the several engineers. In presenting this article we acknowledge the unstinted co-operation of the chief engineers who were interviewed and the assistance of Herbert Chase who contributed material to the presentation.




**REMOTE CONTROL GEARSHIFTING,** introduced last year by Pontiac, Cadillac and LaSalle is now a standard feature on almost all 1939 cars. Various methods are employed to transmit the cross and engaging motions. Some cars use a telescoping rod and tube. In the Pontiac both motions are accomplished by movement of a single rod. Up and down motion of the shift lever causes the control rod to move axially. This motion is transmitted through a flexible cable and tube or Bowden wire to cause the shifter camshaft to move axially. Thus one or the other of the engaging cams engages one or the other of the shifting rods. Swinging the shift lever horizontally rotates the cranked lower end which motion is transmitted through link *A* to a crank on the shifting camshaft which, when rocked, moves the shifter rod and forks fore and aft. A part of the motion involved in the shifting is aided by the servo over-center spring. The shift lever is a stamping made in two halves. Chevrolet employs a vacuum booster cylinder to assist gear shifting. The cylinder furnishes about 80 per cent of the force required to move shifter rod and forks.

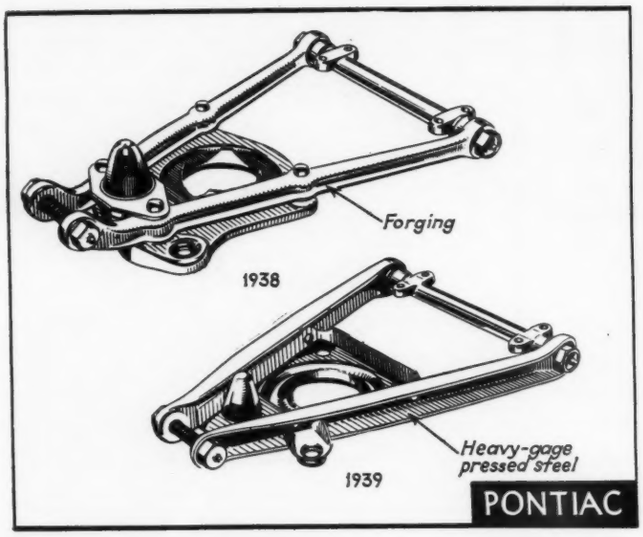

Top view
Stamped in two halves, the edges broached to a smooth surface, coined for the ball fit and then clamped together and brazed in hydrogen
Coined to exact size before the halves are brazed together
Threaded fulcrum bushing
A
Shifting-fork shaft or shift bar
Neutral position
Shift-fork rail, Low and reverse
Shift-bar cams
A
Shift-fork rail, Second and high
Diagrammatic view
Over-center spring
PONTIAC

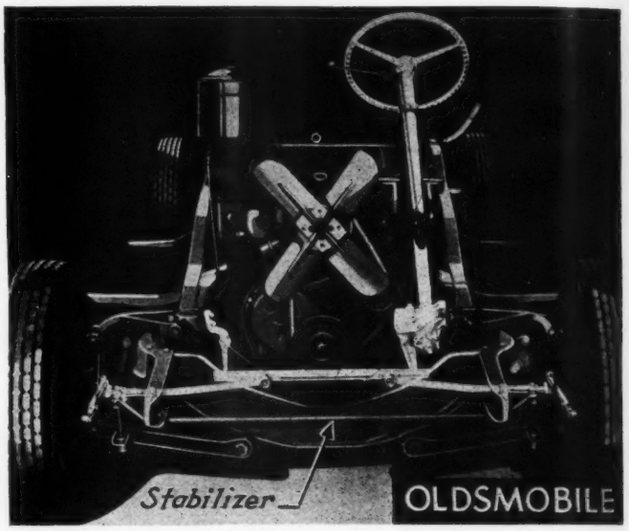


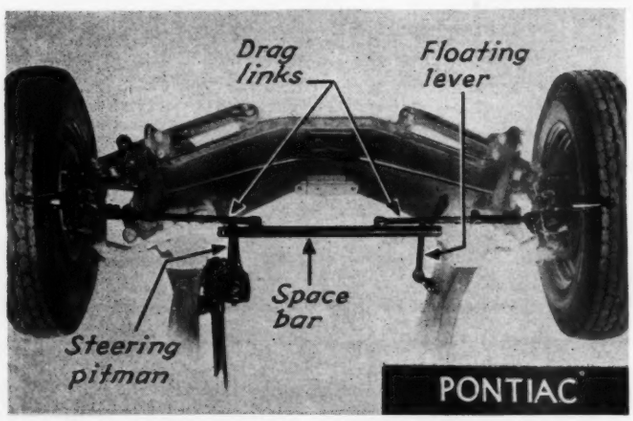



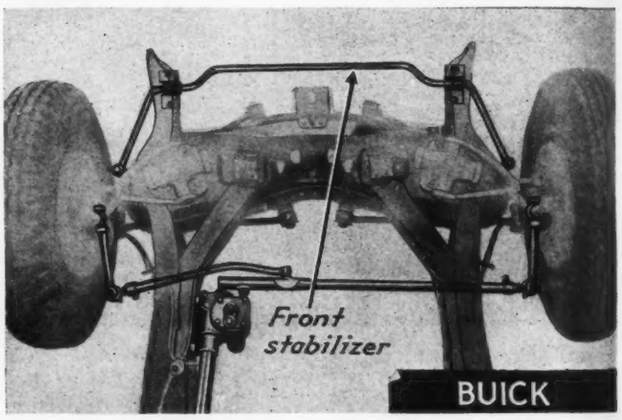
# DESIGN DETAILS of 1939 MODELS . . .

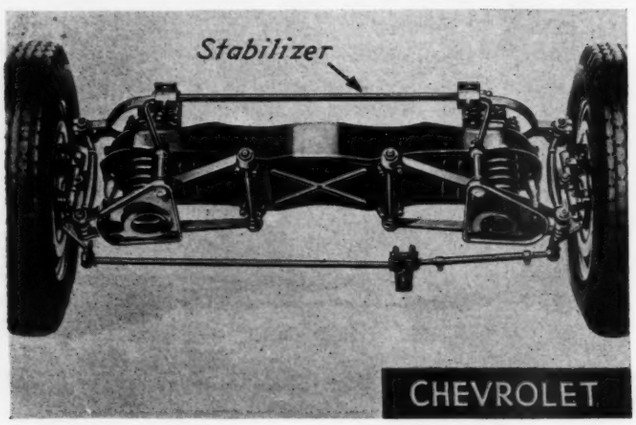
**STEERING MECHANISMS** have been redesigned to obtain better "geometry" in the various motions. Pontiac's tie rod and drag link hookup is new. The drag link is placed crosswise of the car. At its left end it fits onto the pitman arm on the steering gears. The right end is attached to an idler arm. A short tie rod to each steering knuckle is ball-jointed to the drag link. The positions of these various joints have been so selected that, as the wheels rise and fall, the arc described by the outer end of the tie rod approximates that described by the steering knuckle ball. Thus up and down motions of the wheels produce little reaction on the steering linkage. Oldsmobile, Cadillac, LaSalle and Pontiac have stamped wishbones replacing forgings in the front wheel suspension.

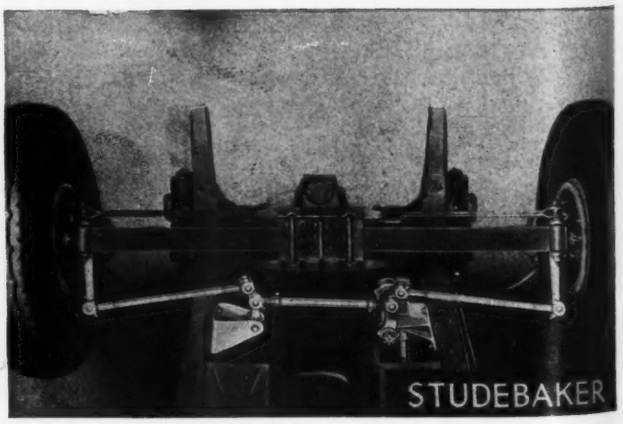


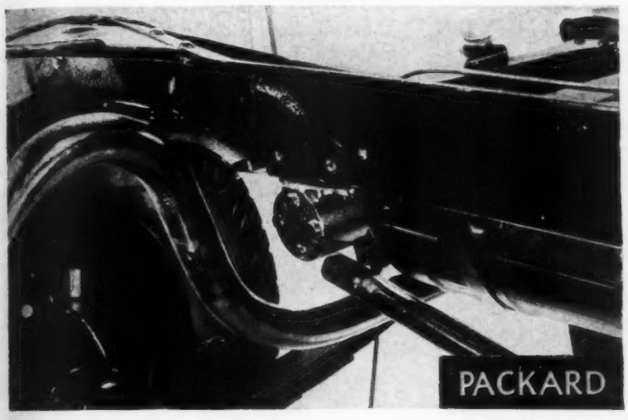



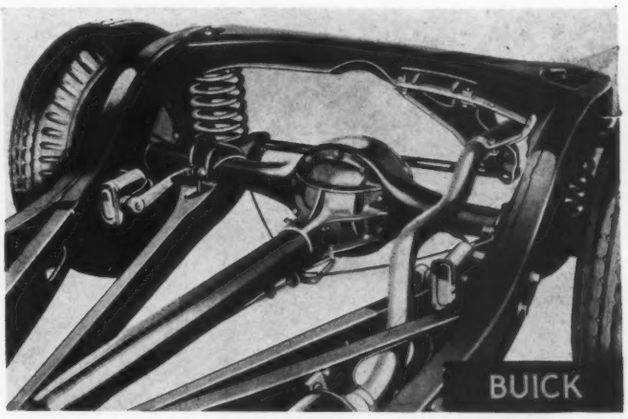



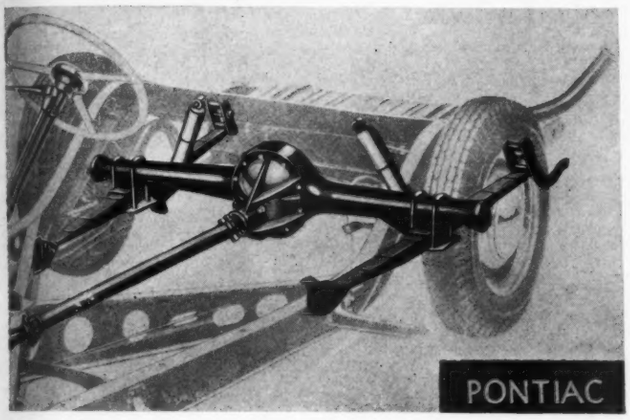



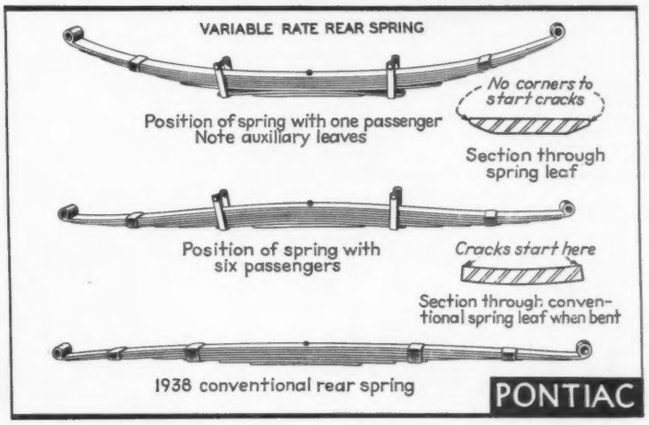



**TYPICAL SUSPENSIONS** as used in the 1939 automobiles. Pontiac employs a "progressive" spring. The change in rate is obtained by spacing the leaves, thus as the load increases, the spring rate progressively increases. With this variable rate spring, the oscillations are substantially the same for both front and rear end. Pontiac shock absorbers are inclined; they take the transverse as well as the up-and-down loads. In the 1939 Packard the radius member is pivoted at one end to the rear axle and frame connection is through a "fifth" shock absorber which is arranged to act as a damper and tends to reduce side sway at high speeds.

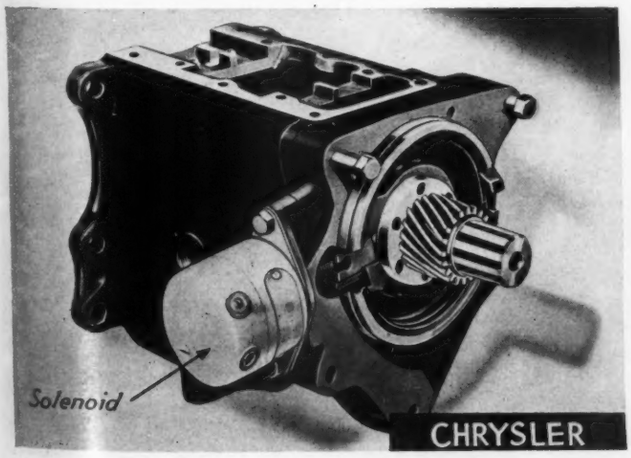


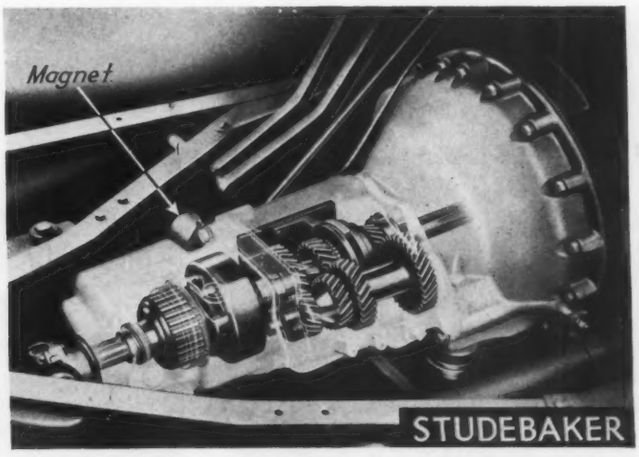



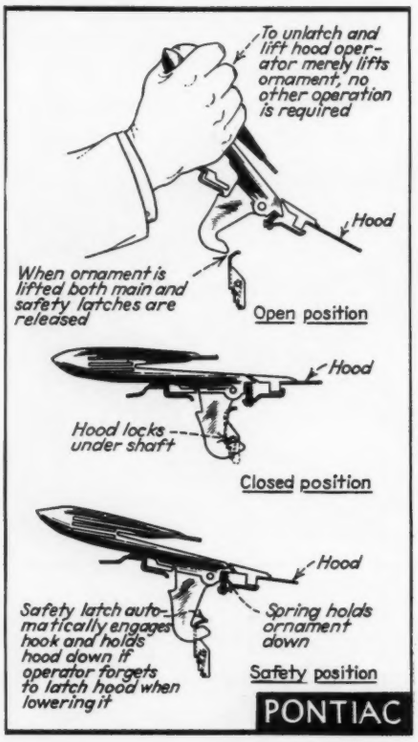


VARIABLE RATE REAR SPRING
No corners to start cracks
Position of spring with one passenger
Note auxiliary leaves
Section through spring leaf
Position of spring with six passengers
Cracks start here
Section through conventional spring leaf when bent
1938 conventional rear spring
PONTIAC

**AUTOMATIC OVERDRIVE** control operated by an electro-magnet is available in Studebaker, Packard, Chrysler and others of the 1939 parade. Depressing the accelerator pedal all the way down first cuts out the ignition, effecting a torque reversal which releases the load. During this instant, while the load is off the gears momentarily, the magnet is energized withdrawing the pawl and throwing the car into conventional gear.

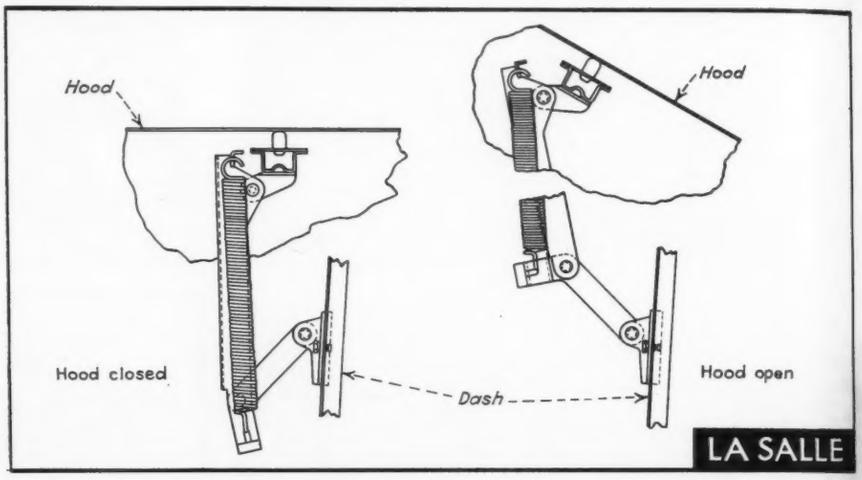


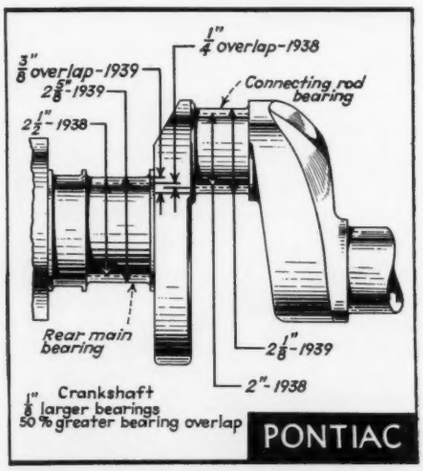



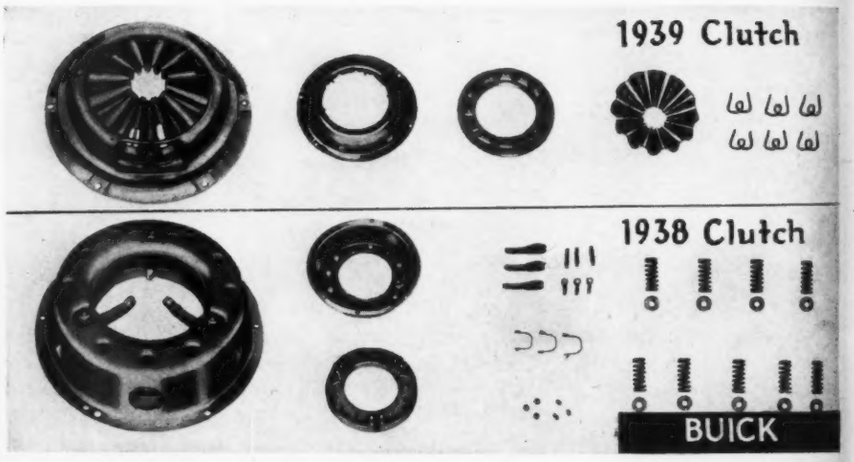
# DESIGN DETAILS of 1939 MODELS . . .

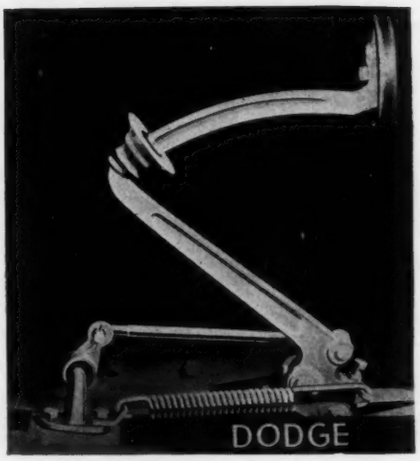

To unlatch and lift hood operator merely lifts ornament, no other operation is required
Hood
When ornament is lifted both main and safety latches are released
Open position
Hood
Hood locks under shaft
Closed position
Hood
Safety latch automatically engages hook and holds hood down if operator forgets to latch hood when lowering it
Spring holds ornament down
Safety position
PONTIAC

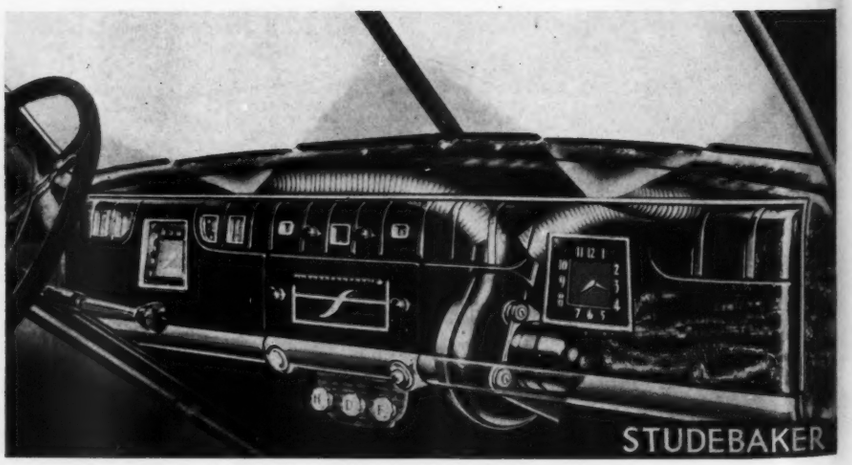
**FURTHER INNOVATIONS** include more extensive use, in General Motors cars, of the Belleville spring type of clutch. In the Buick 40 series, the new clutch assembly has nine parts, replacing 41 parts which were necessary in the 1938 clutch of conventional design. The 1939 Pontiac crankshaft main and connecting rod bearings are of increased diameter permitting more overlap and making the crankshaft more rigid. In the Buick, the malleable iron pinion shaft housing has been replaced with one of gray iron cast around a stub length of torque tube. The remainder of the torque tube is resistance-welded to the stub end. Torque tube thickness was reduced from 7/32 to 3/32 in. Studebaker has a separate motor-driven blower for defrosting.



# FORCED VIBRATIONS

## *And Resonant Frequencies in Machinery*

H. O. FUCHS
*General Motors Corporation*

**Part III—Discussion of deflections that are produced by the application of disturbing forces at regular intervals and the effect of damping forces**

PRACTICAL methods for calculating the natural frequency of a system have been explained in Parts I and II of this series of articles, these appeared in the July and August numbers of *Product Engineering*. Some discussion concerning damping and timing should be added to round out the general subject.

It is a common observation that a small force applied at regular intervals can produce deflections in an elastic system which are many times larger than the equilibrium deflection corresponding to the same force. The amount of magnification of the deflection depends in the main on two factors: (1) the ratio of the frequency of the disturbing force to the natural frequency of the system and (2) the damping factor of the system.

For calculating purposes, the damping force $D$ is assumed to be proportional to the velocity of motion of the vibrating part. This assumption can be expressed mathematically by the equation

$$D = K\ (dx/dt)$$

in which $K$ is a proportionality constant.

Such a damping force will reduce successive amplitudes of a free vibration always in the same ratio. This reduction ratio depends on the ratio of the coefficient $K$ to the product obtained by multiplying the mass by the natural frequency of the system.

If the damping is increased more and more, a point will be reached where the system will slowly return from maximum amplitude to its equilibrium position without swinging over it, and the motion ceases to be periodic. This point is reached when

$$K = (\pi/15)\ (mf)$$

In this expression $m$ represents the total mass, reduced to the point where the damping is applied, and $f$ the natural frequency in periods per minute.

It is customary to call this particular amount of damping "critical" because it divides all possible dampings into those which allow periodic motion and those which prevent periodic motion. The actual amount of damping in a system is usually expressed by a damping factor $d$ the value of which is obtained by dividing the actual damping coefficient by the critical coefficient.

An idea of the meaning of different damping factors can be formed from an analysis of Fig. 1, which shows time-displacement charts of a freely vibrating system with different amounts of damping. For comparison the curves in Fig. 1 are plotted with the undamped vibration in dotted lines and the damped vibrations in full lines. Besides the decrease in amplitudes, it is interesting to note

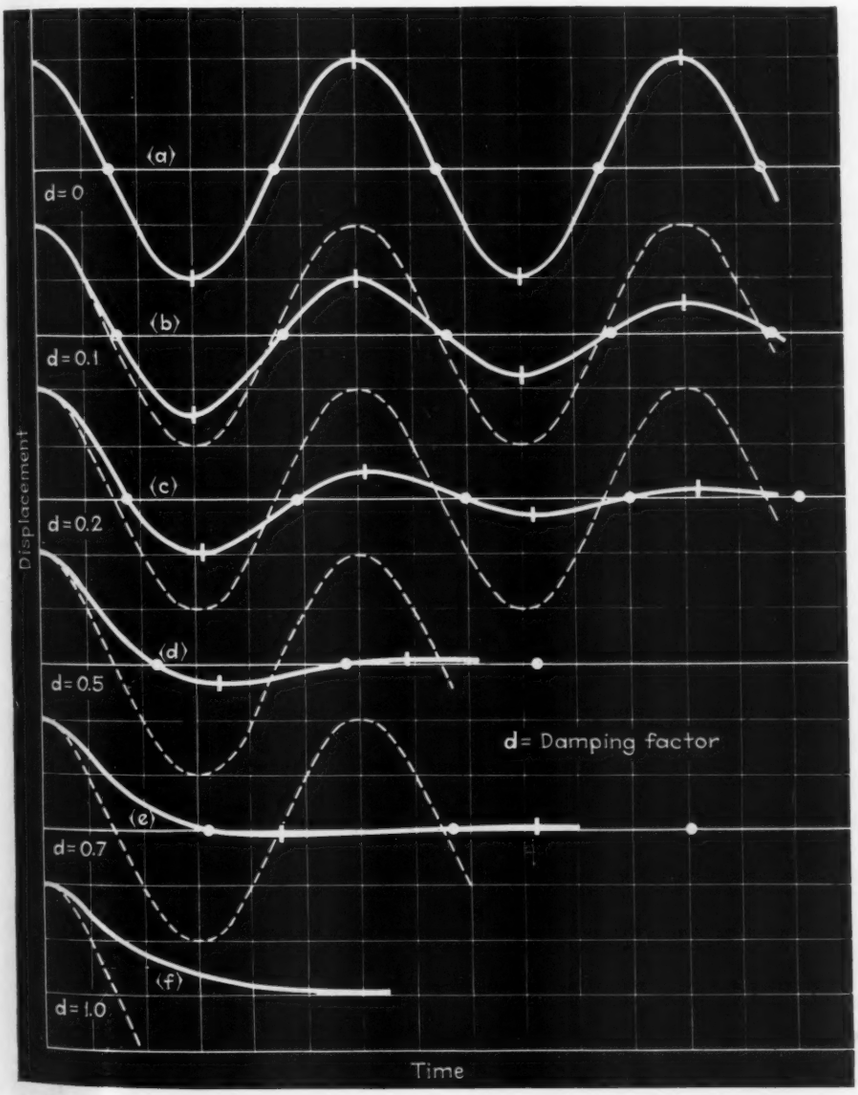



*Fig. 1—Time-displacement charts of a freely vibrating system with different amounts of damping showing decay of free vibrations and lengthening of the period*

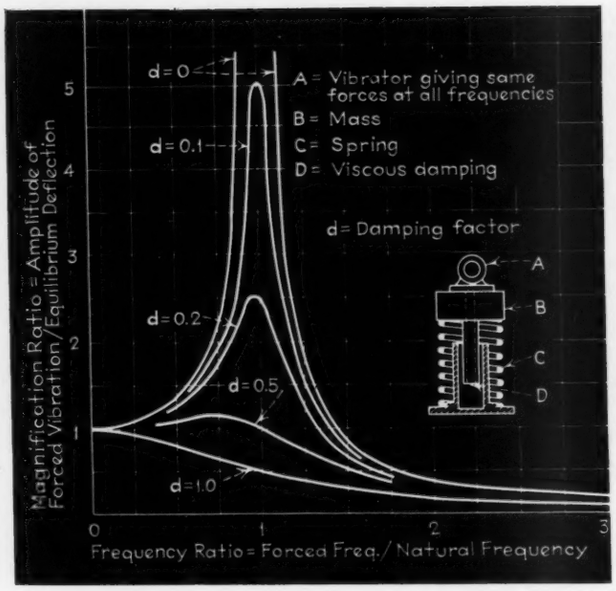



*Fig. 2—Response curves of forced vibrations of spring mounted mass with viscous damping plotted for different damping factors*

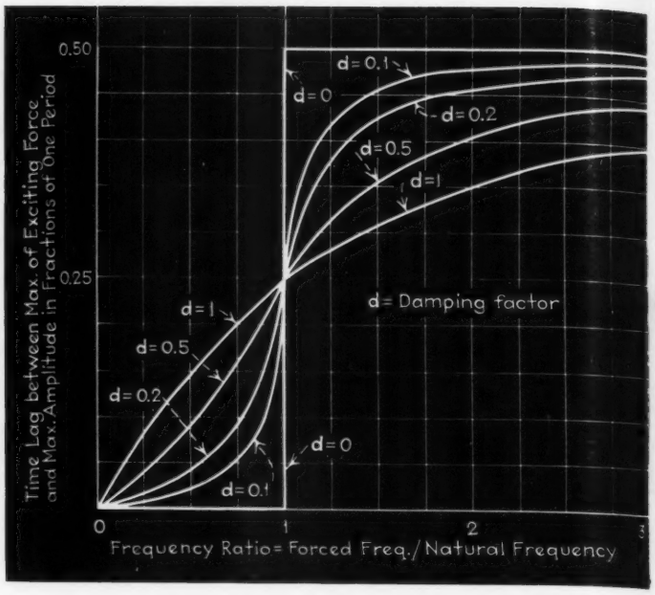



*Fig. 3—Time lag for forced vibrations expressed as a fraction of the period plotted over the frequency ratio for various damping factors*

the lengthening of the period and the unsymmetry of each half period.

The preceding remarks about damping help to explain the meaning of $d$ in the response curves shown in Fig. 2, in which the magnification ratio $a/s$ is plotted over the frequency ratio $R$ for various amounts of damping. Fig. 2 contains the most important information about forced vibrations. The frequency ratio $R$ is the ratio of the frequency with which the system is excited to the natural (undamped) frequency of the same system. The magnification ratio $a/s$ is the ratio of the maximum amplitude $a$ of the forced vibration to the equilibrium deflection $s$ which would be caused by the maximum of the harmonic exciting force if it were acting statically.

The curves in Fig. 2 are plotted for various values of $d$ from the following equation:

$$\frac{a}{s} = \frac{1}{\sqrt{(1-R^2)^2 + (2\,dR)^2}}$$

In experimental investigations of a vibration problem, it is often possible to obtain valuable clues for the determination of the frequency ratio and the amount of damping by observing the time lag or phase angle between maximum exciting force and maximum amplitude. Fig. 3 shows this time lag, expressed as a fraction of the period, plotted over the frequency ratio for various damping factors. To obtain the phase angle, it is only necessary to multiply the fractions with 360 degrees. Knowledge of the phase angle is also important when designing and operating balancing machines and similar apparatus.

All the curves in this article were calculated with the following assumptions:

(1) That the exciting force varies as a sine function of time.

(2) That the free undamped vibrations of the system are harmonic, and

(3) That the damping is linear, that is, proportional to velocity.

Of these assumptions, the one about the damping is least justified by actual practice, but most necessary for analysis of the problem. To apply the analysis to practice, it is often necessary to introduce an "equivalent" damping factor, that is the linear damping factor which would absorb as much energy during one cycle as the actual damper. This equivalent damping may vary with both frequency and amplitude. In a constant dry friction damper the equivalent $d$ will be smaller for big amplitudes than for small ones. In a turbulent liquid dashpot, the equivalent $d$ will increase with frequency and amplitude.

## *Current Quotations*

"Every great business we had was born of a man or men who were the driven slaves of an idea and whose deepest satisfaction was that their faith in their idea was confirmed by other men's finding it useful."——W. J. CAMERON, *Ford Motor Company.*

"Most concerns pass through periods of prosperity and depression. All, of course, are affected by periods over which they have little control. Many of them, however, bring this condition about as the result of their own individual policies. In this present period, I venture to state that in spite of the necessary adjustment of the world's economic conditions before the depression can end, research will play its part as never before and that those industries which sponsor and support research and, in consequence, develop and produce new products for which there will be a general demand, will be the ones in the forefront in the march from depression to prosperity."——DR. A. E. WHITE, *Director of Department of Engineering Research and Professor of Metallurgical Engineering, University of Michigan, from an address at the Chicago Engineers' Club.*

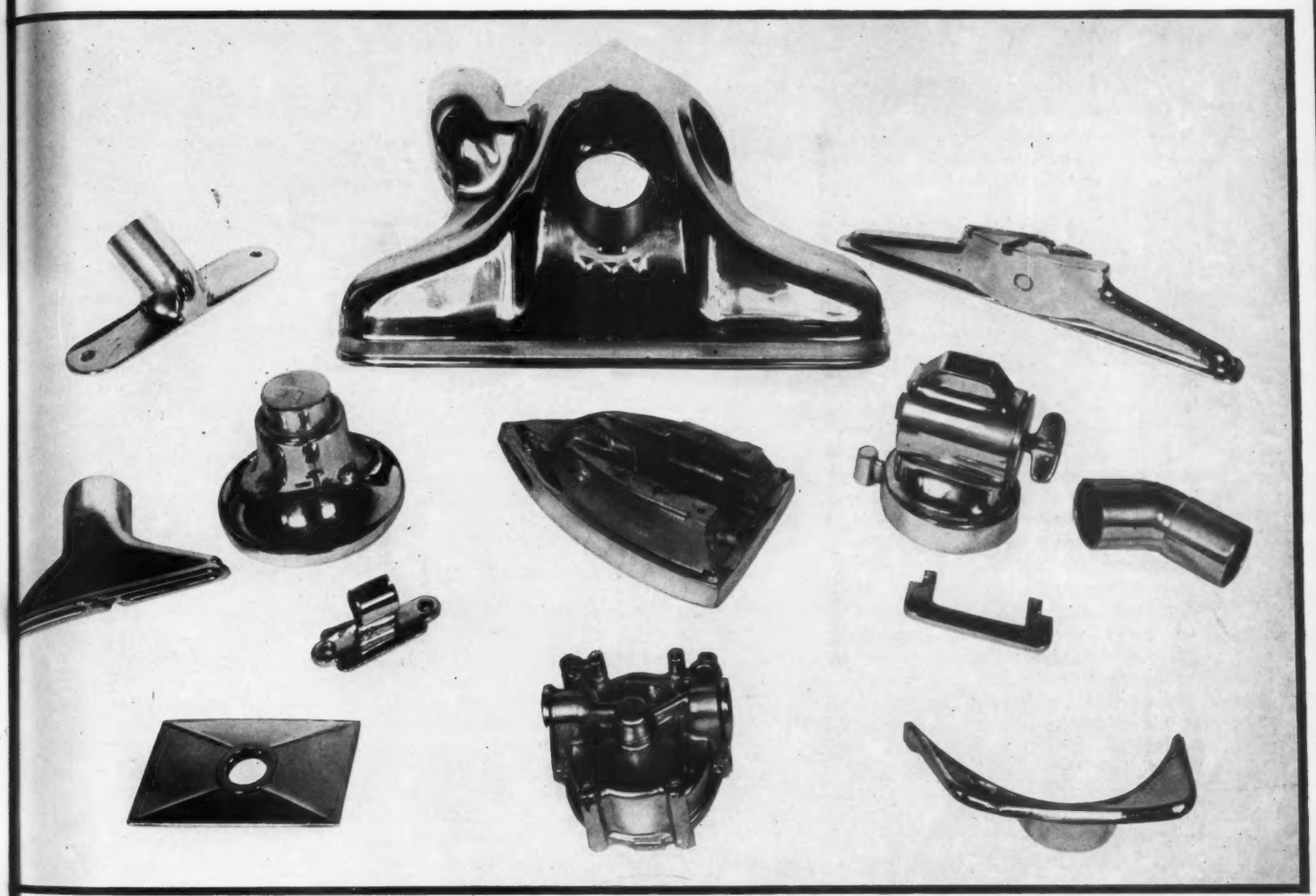
"What we need today, is not so much criticism of the machine, but an intelligent effort on the part of the intelligensia and the idealists to teach our people how to wisely use the leisure time the machine has provided for them."——DR. JAMES SHELBY THOMAS, *President of Chrysler Institute of Engineering.*

"Engineering as such is looked upon by many people as something that is narrow, restricted and understood only by a very few people who have no sense of the drama of life. One has only to think of the vast strides that have been made in our civilization by engineering and industry to recognize in it the greatest drama that does exist in life. Without the fundamental standards that have been set up by research and engineering, many of the things that we enjoy and many of the things that have made life worthwhile, in fact have served to save life, would be missing from our organized society."——GEORGE W. ELLIOTT, *Past-President, National Fire Protection Association.*

# PLATING ALUMINUM

## *For Appearance and for Wear Resistance*

RAYMOND F. YATES, *KROME-ALUME, INC.*



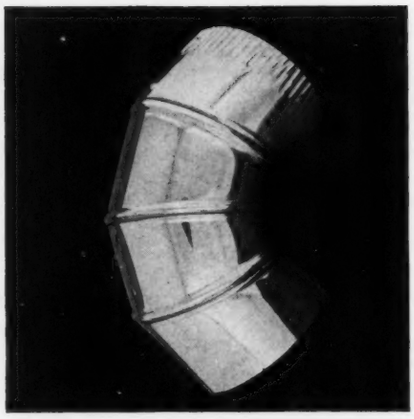
*A group of aluminum sand castings and die-castings plated by the Travers' process to obtain good appearance and serviceability*

**A discussion of a process in which aluminum is anodized and nickel plated. Sheet material so treated can be formed without injuring the coating and also can be plated with other metals**

ALUMINUM when classified on the basis of chemical behavior during electroplating is such as to place it among the recalcitrant metals. Although from time to time patents have been issued and many methods have been proposed for applying a coating of copper or nickel to this useful metal, it was not until 1934 that a practical, cheap and commercially suitable process appeared. There was not only the problem of plating aluminum, but there was also the problem of plating aluminum at a cost that would not place the result beyond the budget of the designing engineer.

Cautious analysts will understand that there is something more to plating aluminum than mere decoration and appearance. To provide the metal with a bright, durable and highly adhesive plate of nickel is one thing, and to give the parent metal a hard surface of chromium for setting up a better resistance to wear is quite another thing.

Since the surface of aluminum is soft it can be easily nicked and scratched. When plated with, say a thousandth of an inch of well-deposited nickel, the plated surface is more resistant. When plated with chromium over the nickel, the plated surface is still more resistant and can be ranged with most of the other metals in its ability to resist scratching and nicking, inasmuch as chromium is harder than steel. Furthermore, if the chromium surface is deposited slowly over a period of days, and thus obtain what is ordinarily known as hard chromium, the plated aluminum



*Aluminum stove pipe that was formed, crimped and assembled after the sheet was plated without damage to the finish*

will resist long periods to heavy abrasion.

Considered on the basis of performance and life, and quite apart from purely decorative considerations, the ability to resist abrasion is most important. By way of illustration, if certain parts of printing presses were made of hard chromium plated aluminum, it is estimated that the speed of the presses could be doubled. Bearing surfaces can be formed with such a deposit. The skin of chromium does not need to be more than a few hundred thousandths of an inch in thickness to obtain good wearing qualities. With the new Travers Krome-Alume process the plating is not affected by high heat. This is demonstrated by tests made with electric flatirons which have plated aluminum sole plates.

For many years manufacturers have considered using sheet aluminum for small pocket articles but the necessity for cheap fabrication has been an obstacle to the use of such material. For example, riveting the hinges in a cigarette case is a costly operation. To keep cost down, parts such as hinges are soldered in place and hence brass must be used. Brass is heavy for pocket articles. Aluminum is lighter than brass but just as strong. With the new process only fifteen minutes are required to "flash" large aluminum sheets or strip with sufficient nickel to insure the application of solder by ordinary means and methods.

### *Quality of Nickel Plating*

Many methods used in the plating of aluminum require much time. Oftentimes a deceivingly good plate has been deposited only later to find that the quality was almost purely optical. Upon slight strain the plating parted company with the aluminum. Copper instead of nickel has also been tried as a first coat. Reference to the electrochemical series of metals and their various potentials will show that copper should not be placed next to aluminum. Expense has also been a factor to be considered when plating with copper.

In the Travers Krome-Alume Process, only two solutions are used, ordinary oxalic acid and commercial sodium cyanide. About fifteen minutes are required to prepare the aluminum for plating in the ordinary nickel bath, either bright or gray. The cost of this preparation runs about one quarter cent to the square foot.

With 90 per cent of the commercial alloys (either sheet, die-cast, sand cast or wrought) in use at the present time the nickel has a high degree of adhesion. Nickel-plated 2S or 3S aluminum in sheet form can be punched, bent and formed without disturbing the nickel.

It should be pointed out, however, that this process does not lend itself to the direct deposition of chromium or copper, although both of these metals can be plated on aluminum. The adhesion of chromium and of copper, however, is not as good as that of nickel. A deposit formed in 15 min. in a cold nickel bath is sufficient to stand up under the strain imposed by the chromic acid in chromium plating. After the nickel is put in place almost any metal can be placed over it. On certain of the aluminum alloys, not even three days' exposure to the chromium bath will tend to lift the nickel plate.

### *Temperature Resistance*

Aluminum plating by this process has high resistance to temperature shock, a test that is far more severe than salt spray or any of the other standard tests. It is found that a well-plated piece of aluminum at a temperature of minus 30 deg. F. can be plunged into a saturated atmosphere at 140 deg. F. without any damage even though the article is subjected repeatedly to this treatment. Aluminum with a fine-grained deposit of nickel has been exposed more than 400 hr. in salt spray before breaking down under erosion and corrosion.

Although other workers in this field attempt to remove the coating of oxide that is formed on the surface of aluminum because it interferes with plating, even though it is but a few millionths of an inch thick, Travers, the inventor of the Krome-Alume process, purposely builds up this oxide coating by first anodizing the aluminum in a bath of oxalic acid. After the anodic film has been established, the article bearing it is then subjected to the action of a mild solution of special chemical. Here this anodic film is modified in some manner not yet thoroughly understood. It is known, however, that this anodic film of oxide is partially removed and that this requires that each different alloy be left in the chemical solution for a pre-determined length of time depending on the composition. Some alloys require as little as 38 sec., some as long as 12 min. After rinsing, the article treated is then ready to be plated in any of the standard bright nickel baths or in either cold or hot gray nickel baths.

*Plated aluminum tea kettle after four years of use on a gas stove. Proof that the coating can withstand temperature changes*

Whatever the modification of the anodic surface does, it is known that the nickel forms a tight bond with the basic metal and that in no sense does the adhesion depend upon etching. It is found that when a piece of brass is soldered to the nickeled surface, that the film of solder will be ruptured and the nickel plate will not leave the aluminum. Inasmuch as there is no etching, the aluminum will take a beautiful buff.

The process is either being used or its use is being contemplated at the present time in the fields of photography, printing, ordnance, radio, jewelry, measuring instruments, vacuum cleaners, electric motors, wall-board insulation, cooking utensils, electric heating devices, gas engines, automobiles, railway coaches, buses, trays, dies, paper making machinery, and optical goods.

### *Transformer Capacity*

It should be pointed out that the process is not, from a purely technical viewpoint, a process for plating aluminum. Rather it is a process for treating aluminum so that it can be plated in any of the standard nickel plating baths. Transformers for anodizing are in use which have capacities ranging between 5 and 60 kw. For average job plating a transformer of about 15 kw. is quite suitable.

For ordinary decorative plating where chromium is to be used, it is found that the aluminum does not need to be given any greater thickness of nickel than do any other of the common metals. As little as 0.002 in. appears to be sufficient. After aluminum is prepared for plating, it may thereafter be treated just like any other metal.

# MAGNET COIL DESIGN

## *With Data for Estimating Essential Factors*

GRAHAM LEE MOSES
*Westinghouse Electric & Manufacturing Company*

**Discussion of problems involved in designing magnet coils to produce a desired magnetic pull with given air gap and imposed voltage for continuous and for intermittent service**

MAGNET COILS are in form the simplest of electrical devices. The design, manufacture and application of magnet coils, however, present complicated engineering and shop problems. From an engineering point of view, a magnet coil must produce sufficient magnetic pull to operate a particular device; dissipate the heat generated within itself without exceeding permissible temperature limits; and be insulated from the metallic parts of the apparatus. In addition, the winding must be insulated between turns and layers from terminal to terminal against both normal and maximum voltage surge peaks. Since each of these requirements presents a separate group of problems, each one will be discussed individually.

Magnet design problems usually involve the development of a coil to meet specific requirements of magnetic pull evaluated in terms of ampere-turns. The physical limits of the coil are generally established previously. The design of every coil starts with a preliminary estimate of the ampere-turns required to produce the desired force. It is preferable to obtain these data by testing the actual device and in any event this should be done before the final coil design is established as the factors involved are complicated. The accurate calculation of the required ampere-turns is difficult and is beyond the scope of this article. (Editor's Note: For a quick and easy method of estimating ampere-turns in d.c. magnet coils see the Reference Book Sheets, in this issue of *Product Engineering*. Graphs are there presented showing the effect of wire size and mean diameter on ampere-turns per volt.)

### *Air Gap and Other Factors*

Since the air gap is ordinarily the determining factor, a set of curves is shown in Fig. 1 to help approximate the ampere-turns required for various pulls at different air gaps. The ampere-turns will, however, vary considerably with the shape and size of the magnetic circuit, and also with the shape of pole faces and type of iron used. The curves in Fig. 1 are intended to be used only for preliminary estimates of the ampere-turns.

Permissible temperature is determined by the class of insulation used. In Table I are listed and classified the kinds of insulation available for use on magnet coils with permissible temperatue rises based on 40 deg. C. as the maximum ambient temperature.

Continuous ratings are based on the maximum permissible temperature rises shown in Table I. Since most magnet coils, however, are not energized continuously some consideration must be given to the duty cycle. The simplest example is a coil which is energized only a part of the time on a constant voltage circuit where the equivalent voltage (square root of mean square), in so far as heating of the coil is concerned, is less than the intermittently applied voltage.

The curve in Fig. 2 shows the permissible increase in applied voltage beyond rated continuous voltage of the coil as determined by the percentage of the time energized. To explain further, if a coil is to be used on 250 volts and it is to be energized 60 per cent or less of the time,

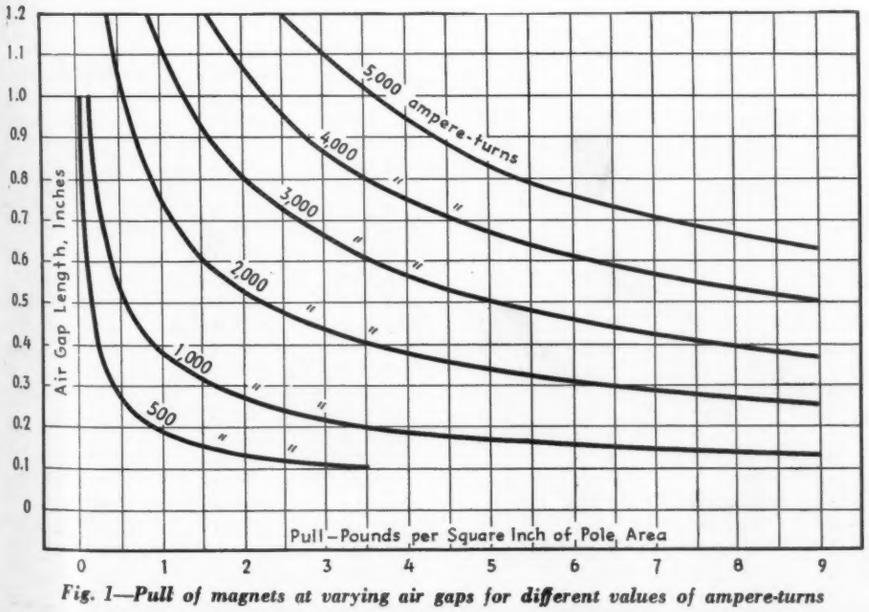



*Fig. 1—Pull of magnets at varying air gaps for different values of ampere-turns*

*Fig. 2—Permissible increase in applied voltage in terms of the continuous voltage rating of coil as determined by the percentage of the time energized on intermittent service*

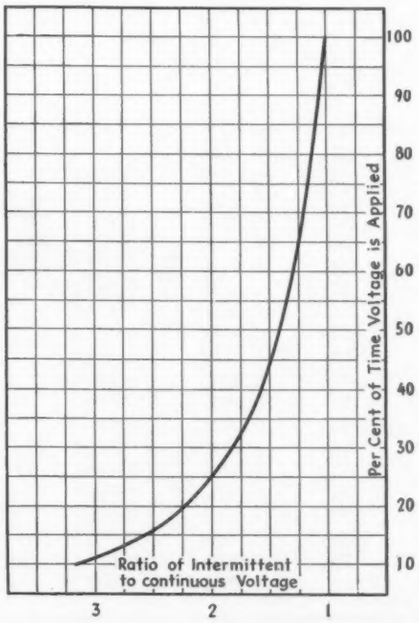


**TABLE I—Limiting Temperature Rise in Deg. C. for Various Insulations**

| | *Class A Insulation Organic, Impregnated (cotton, silk, paper, fullerboard, enamel)* | | *Class B Insulation Inorganic, Impregnated (mica, asbestos, glass textiles)* | |
|---|---|---|---|---|
| | *Measured by Thermometer* | *Measured by Rise in Resistance* | *Measured by Thermometer* | *Measured by Rise in Resistance* |
| Wire wound coils..... | 65 | 85 | 85 | 105 |
| Single layer series coils with exposed surfaces uninsulated or enamelled .... | 90 | — | 105 | — |

and the time that power is on does not exceed ½ hour periods, Fig. 2 shows that the coil can be operated at 1.3 times its normal voltage. For 250 volt service, therefore, a coil having a continuous rating of 192.5 volts will not overheat if energized 60 per cent of the time.

The continuous rating $E$ of a coil for any temperature rise can be obtained as follows:

$E$ = Continuous (square root of mean square) voltage

$R_c$ = Cold resistance at 25 deg.C.

$(t_2 - 25)$ = Temperature rise

$K$ = Constant for particular coil in deg. per watt.

This is dependent on coil surface, wall thickness and construction; and varies with size and shape. It must be determined for a particular coil size by test. It may be estimated from the expression

$K = 1/(AC)$

Where $A$ = Barrel surface of coil in sq.in.,

$C$ = Watts radiated per sq.in. of barrel surface per deg. C. rise as measured by the rise in resistance. Heat radiated varies from 0.01 for thick wall coils to 0.015 watts per sq.in. per deg. C. for thin wall coils.

$$E = \sqrt{\left[\frac{R_c\,(t_2 - 25)}{K}\right]\left[\frac{(t_2 - 25)}{259.5} + 1\right]}$$

Note: For a coil having the following approximate dimensions:

Length = 3¼ in., *O.D.* = 2¾ in., *I.D.* = 1⅛ in., Barrel Surface = 25.9 sq.in.

$K$ = 3 deg. per watt

$C$ = 0.01285 watts per sq.in. of barrel surface per deg. C.

There are in general two types of magnet coil construction: namely, coils which are wound in spools and the "self-sustained" coils which are wound on "universal" machines. Spool-wound coils may be wound with wire using any type of covering depending upon service conditions and the expense justified. This is the simplest type of coil to wind and the easiest to calculate. Provision must be made in the spool construction for a slot in one end-washer or a separate split washer to bring out the starting lead from the bottom layer to the suface.

"Self-sustained" or "universal" wound coils are usually wound with enamel-covered wire on a single tube in a close spiral so that the consecutive turns lie close together. At the same time, the machine winds one or more threads of cotton in an open spiral, so that the cotton lies diagonally along the barrel surface and overlaps the wire travel at each end of the coil. This builds up cotton walls at each end of the coil, laced together by diagonal threads. The cotton also provides channels through the body of the winding so that it can be thoroughly impregnated. On this type of coil the starting lead is usually insulated with varnished cloth and embedded in the cotton end wall so that split starting washers are not required.

Completely insulated coils should not exceed the diameter of the washers, generally they should be ¼ in. less in diameter than the end-washer to leave space for outer insulation. The determination of the various factors, with all dimensions expressed in inches should proceed as follows:

Uninsulated Coil O.D. = Washer O.D. − 1/4 in.

Wall Thickness = $\frac{\text{Uninsulated Coil O.D.} - \text{Tube O.D.}}{2}$

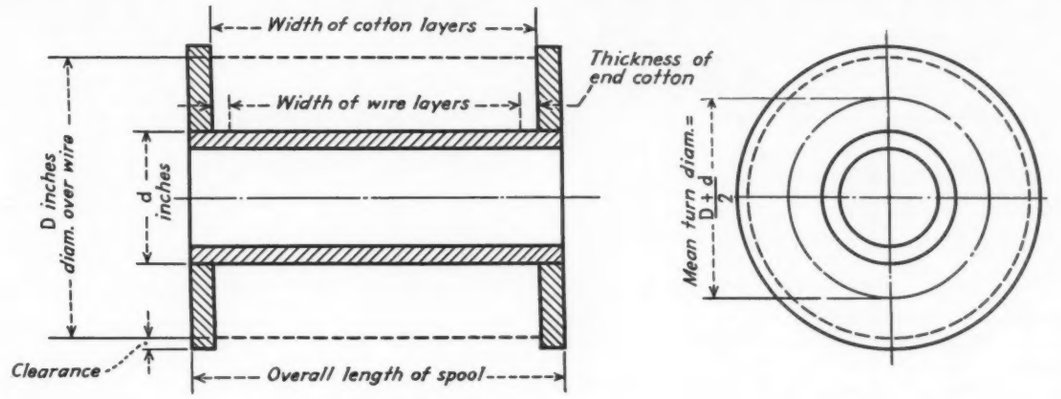
Mean Diameter = Wall Thickness + Tube O.D.

Mean Turn ($M$) = Mean Diameter × $\pi$

Turns per layer ($T$) = $\frac{\text{Winding Space} \times \text{Factor}}{\text{Insulated Wire O.D.}}$

**TABLE II—Data for Universal Wound Coils Using Enameled Wire and Cotton Yarn Layer Insulation**

| *AWG Size* | *Diam. in In.* | | *Per 1,000 Ft.* | | *Winding Factor* | *Conductors Per* | | *Per Cu. In.* | |
|---|---|---|---|---|---|---|---|---|---|
| | *Bare* | *Ins.* | *Res. Ohms* | *Wt. Lbs.* | | *Lin. In.* | *Sq. In.* | *Length Ft.* | *Resist.* |
| 20 | 0.032 | 0.0341 | 10.35 | 3.092 | 0.92 | 27 | 729 | 60.7 | 0.629 |
| 21 | 0.0285 | 0.0306 | 13.05 | 2.452 | 0.92 | 30 | 900 | 75.0 | 0.98 |
| 22 | 0.0254 | 0.0275 | 16.46 | 1.945 | 0.92 | 33 | 1,090 | 90.6 | 1.49 |
| 23 | 0.0226 | 0.0244 | 20.76 | 1.542 | 0.92 | 37 | 1,370 | 114.0 | 2.37 |
| 24 | 0.0201 | 0.0219 | 26.17 | 1.223 | 0.92 | 42 | 1,765 | 147.0 | 3.84 |
| 25 | 0.0179 | 0.0197 | 33.00 | 0.9699 | 0.91 | 46 | 2,120 | 177.0 | 5.84 |
| 26 | 0.0159 | 0.0175 | 41.62 | 0.7692 | 0.91 | 52 | 2,710 | 225.0 | 9.35 |
| 27 | 0.0142 | 0.0157 | 52.48 | 0.6100 | 0.91 | 58 | 3,370 | 281.0 | 14.73 |
| 28 | 0.0126 | 0.0141 | 66.17 | 0.4837 | 0.91 | 64 | 4,100 | 342.0 | 22.65 |
| 29 | 0.0113 | 0.0126 | 83.44 | 0.3836 | 0.91 | 72 | 5,190 | 432.0 | 36.25 |
| 30 | 0.0100 | 0.0113 | 105.2 | 0.3042 | 0.90 | 79 | 6,300 | 525.0 | 55.2 |
| 31 | 0.0089 | 0.0100 | 132.7 | 0.2413 | 0.89 | 89 | 7,930 | 660.0 | 87.5 |
| 32 | 0.008 | 0.0091 | 167.0 | 0.1913 | 0.88 | 96 | 9,210 | 768.0 | 128.0 |
| 33 | 0.0071 | 0.008 | 211.0 | 0.1517 | 0.88 | 110 | 12,100 | 1,008.0 | 213.0 |
| 34 | 0.0063 | 0.0072 | 266.0 | 0.1203 | 0.87 | 121 | 14,600 | 1,217.0 | 324.0 |
| 35 | 0.0056 | 0.0064 | 335.0 | 0.0954 | 0.86 | 134 | 17,950 | 1,495.0 | 501.0 |
| 36 | 0.0050 | 0.0058 | 423.0 | 0.0757 | 0.85 | 146 | 21,300 | 1,775.0 | 750.0 |
| 37 | 0.0045 | 0.0054 | 533.0 | 0.0600 | 0.85 | 163 | 26,550 | 2,210.0 | 1,177.0 |
| 38 | 0.0040 | 0.0047 | 672.0 | 0.0476 | 0.85 | 181 | 32,700 | 2,730.0 | 1,833.0 |
| 39 | 0.0035 | 0.0041 | 848.0 | 0.0377 | 0.85 | 207 | 42,800 | 3,570.0 | 3,010.0 |
| 40 | 0.0031 | 0.0037 | 1,069.0 | 0.0299 | 0.85 | 230 | 52,900 | 4,410.0 | 4,700.0 |


Width of cotton layers
Thickness of end cotton
Width of wire layers
D inches diam. over wire
d inches
Mean turn diam. = D + d / 2
Clearance
Overall length of spool

Size of wire number _____ Wire diam. inches _____

Weight of wire lb. per M. ft. ($w$) = _____ Winding factor ___

Turns per layer ($T$) = $\dfrac{\text{Winding space} \times \text{factor}}{\text{Insulated Wire O.D.}}$ =

Number of layers ($L$) = $\dfrac{(D - d) \times \text{winding factor}}{2 \times \text{Insulated wire O.D.}}$ =

Mean turn length in inches ($M$) = $\dfrac{(D - d) \times \pi}{2}$ =

Total turns ($N$) = $T \times L$ =

Length of wire ($B$) in M. ft. = $\dfrac{M \times N}{12 \times 1{,}000}$ =

Total weight of copper in lb. = $w \times B$ =

Resistance in ohms of wire per M. ft. at 25 deg. C. ($R_1$) =

Resistance in ohms of wire per M. ft. at $t_2$ deg. C. ($R_2$)

$= R_1 \left[1 + 0.00386\ (t_2 - 25)\right]$ =

Resistance in ohms of mean turn length ($R_m$) = $\dfrac{M}{12} \times \dfrac{R_2}{1{,}000}$ =

Resistance of coil at $t_2$ deg. C. ($R$) = $R_2 \times B$ =

Watts radiated at $E$ volts at $t_2$ deg. C. = $\left(\dfrac{E^2}{R}\right)$ =

Watts radiated per sq. in. of barrel surface at $E$ volts and $t_2$ deg. C.

$= \left[\left(\dfrac{E^2}{R}\right) \Big/ (\pi D \times \text{width of winding space})\right]$ =

Ampere-turns $IN = \dfrac{E}{R_m}$ =

*Fig. 3—Typical form of calculation sheet that can be used for estimating factors involved in magnet coil design*

Layers ($L$) = $\dfrac{\text{Wall Thickness} \times \text{Factor}}{\text{Insulated Wire O.D.}}$

Total Turns ($N$) = Turns per layer × Layers

Coil Resistance = $N \times \dfrac{M}{12} \times \dfrac{R_2}{1{,}000}$

Where $R_2$ = Resistance of wire in ohms per 1,000 ft. at temperature $t_2$ deg. C.

On spool-wound coils, where the wire is carefully wound in layers, a winding factor of 95 per cent should be used in determining the turns per layer, and 100 per cent in determining the number of layers. If the coils are wound promiscuously without regard to even layers, a winding factor of 95 per cent should be used for both turns and layers.

For self-sustained coils wound in universal machines, the calculation of the winding space and use of the winding factor is more complicated. In Fig. 3 is shown an excellent form of calculation sheet for estimating the various factors involved. This form may also be used for simpler types of coils by omitting some of the factors. The winding factor varies for different wire sizes, because of the cotton yarn occupying a differing percentage of the winding space. A list of winding factors of all sizes of wire from No. 20 to No. 40 AWG is given in Table II along with other useful data. These data are shown graphically in Fig. 4.

From the conductors per sq.in. the number of turns for any given wall area can be quickly calculated. Also the resistance for any size of spool can be estimated from the active cubic inches (wall area multiplied by mean turn). The product of active cubic inches of winding and ohms per cubic inch for a given wire size is a close approximation of the resistance.

The ground insulation is usually supplied by the spool or insulating tube on which the coil is wound. For operating voltages below 500 it can usually be assumed that an insulating spool which is mechanically satisfactory will have suitable electrical characteristics. At 500 volts and above additional precautions must be taken to secure additional resistance to creepage by sealing any cracks between end-washers and tube. Spools made from fiber, micarta and various forms of molded plastic phenolics are generally found satisfactory. In the or-

## TABLE III—Analysis of Magnet Coil Design Data

*Specifications of Selected Coil*

| | | |
|---|---|---|
| Barrel Surface | = | 25.9 sq. in. |
| Active Winding | = | 12.75 cu. in. |
| Temperature Constant ($K$) | = | 3 deg. C. per watt |
| Total Turns | = | 30,500 |
| Resistance | = | 4,280 ohms at 25 deg. C. |

| Watts | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Total* | *Per Cu. In.* | *Temp. Rise Deg. C* | *Hot Res. Ohms* | *Volts* | *Amp.* | *Amp. Turns* | *Amp. Turns Per Watt* | *Amp. Turns Per Cu. In.* |
| 5 | 0.39 | 15 | 4,550 | 151 | 0.033 | 1,010 | 225 | 79 |
| 8 | 0.627 | 24 | 4,670 | 194 | 0.0414 | 1,260 | 157 | 99 |
| 10 | 0.78 | 30 | 4,770 | 218 | 0.046 | 1,400 | 140 | 110 |
| 15 | 1.18 | 45 | 5,010 | 275 | 0.0547 | 1,670 | 111 | 130 |
| 20 | 1.57 | 60 | 5,250 | 325 | 0.062 | 1,890 | 95 | 148 |
| 30 | 2.35 | 89 | 5,740 | 415 | 0.0725 | 2,210 | 74 | 174 |
| 40 | 3.14 | 121 | 6,260 | 500 | 0.08 | 2,440 | 61 | 192 |

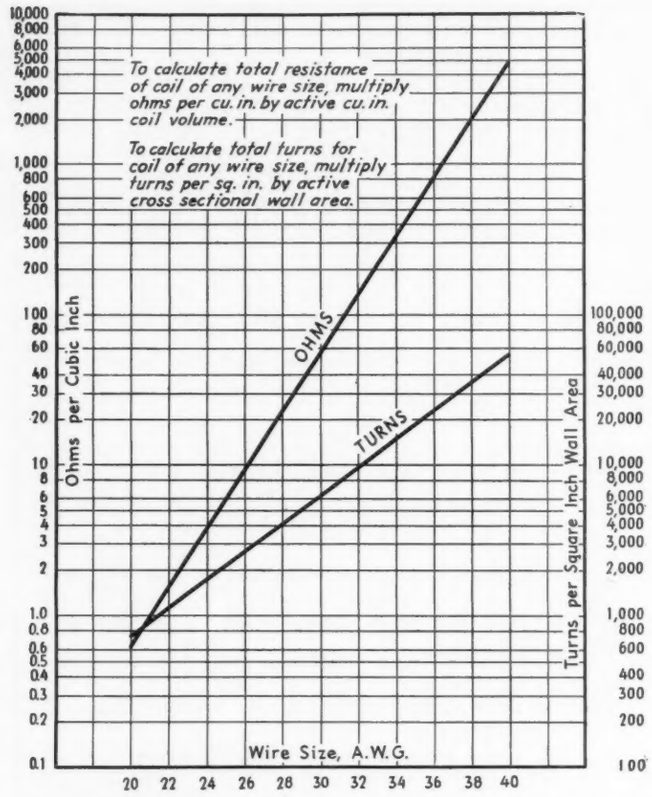



***Fig. 4—Resistance and turns constants for wire sizes from number 20 to number 40 A.W.G. on universal wound coils***

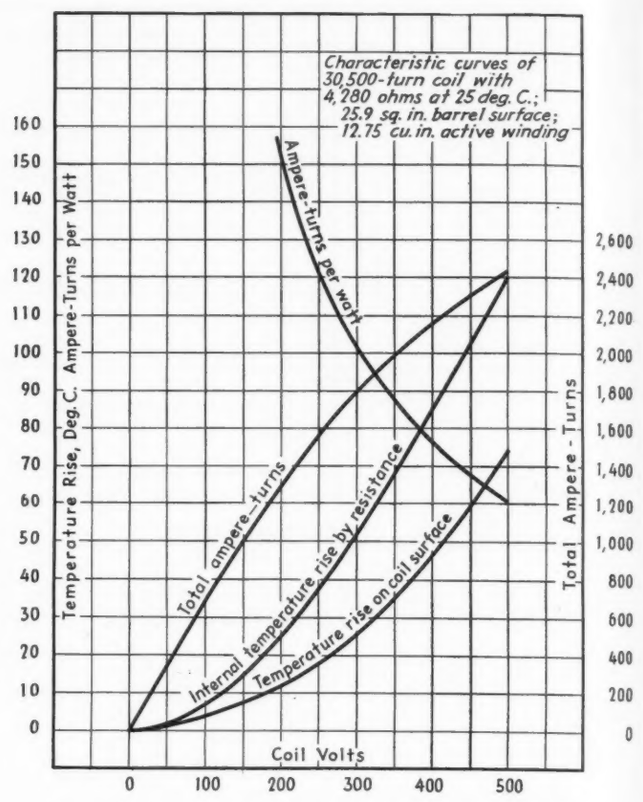



***Fig. 5—Magnet coil data presented graphically that shows the effect of coil volts on the temperature of surface and the internal temperature rise***

dinary sizes of magnet coil, tubes with $\frac{1}{16}$ in. thick walls and $\frac{1}{8}$ in. thick end washers are conventional.

Layer insulation as well as turn insulation is usually furnished by wire covering and, therefore, the kind of wire covering should be selected with care. For "universal wound" coils having interlaced cotton yarn, enameled wire is generally satisfactory. Spool wound coils may use enameled wire if the wall thickness is not so great as to build up enough pressure to damage the enamel, in which event paper and enamel covered wire is satisfactory. Where the operating temperature is in excess of that permitted for Class A materials, Class B insulated wire must be used. Asbestos covered wire has long been used for such applications and lately "Glasweve" insulated wire is coming into prominence. The latter has a better space factor than asbestos covered wire and has proven highly satisfactory.

An outer wrapper should be applied to most magnet coils to insulate the start and finish leads from each other and the coil surface. For coils rated up to 200 volts a single layer of 0.010 in. treated cloth is generally used. Above 200 volts 0.010 in. fishpaper and mica is preferable. For some coils, two or more layers of wrapper are required where line voltage surges may be 1,500 to 2,500 volts. A half lapped layer of cotton finishing tape should be used on Class A magnet coils. On Class B coils asbestos or "Glasweve" tape should be used.

Magnet coils for a.c. present problems that are in addition to those involved in d.c. coils. On a.c. magnets the current is not limited by resistance but by impedance which is a combination of resistance and inductive reactance. This latter factor changes as the magnet armature moves so that the current taken at a given voltage is much less with the air gap closed than the air gap open. The designer is primarily interested in the open gap current as it affects pick-up ampere-turns and in the closed gap as it affects heating.

### *Determining Impedance*

On most a.c. magnets the reactance is so much greater than the resistance that the resistance can be neglected as a factor of impedance. To determine the impedance $Z$ an existing coil should be tested on the magnetic circuit at open and closed gap. From this data the impedance can be calculated thus:

$Z$ = Impedance in ohms
$E$ = Volts applied to coil
$A$ = Amperes through coil
then $Z = E/A$

From this the magnetic constant $Q$ should be calculated for both conditions of gap as follows:

$Q$ = Magnetic constant of the device
$Z$ = Ohms impedance
$N$ = Turns
$F$ = Frequency in cycles per second
then $Q = Z/(N^2F)$

Once these magnetic constants have been established the impedance of a coil of any number of turns can be calculated from the same formula arranged in this form:

$$Z = QN^2F$$

Once a design has been worked out it will be interesting and instructive to analyze the component factors so as to obtain a clearer picture of the effect of the important factors; to illustrate this a coil has been selected having the characteristics given in Table III. The detail analysis of this coil is also shown in Table III. The same data are shown graphically in Fig. 5 which illustrate the effect of coil volts on surface and internal temperature rise, as well as total ampere-turns and ampere-turns per watt.

An important procedure in designing a magnet coil is to analyze its characteristics by drawing up its basic curves. Study of the characteristics of the finished design will disclose new angles which will help in producing better subsequent designs. Also, if data derived by studies of this nature are filed time can be saved later when calculating similar factors.

# CONTRIBUTORY INFRINGEMENT

## *Considerations Involving Engineering Design*

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*Toulmin & Toulmin*

**Some points in patent law which clarify the status of design activities and their relation to causes for legal action that involve questions dealing with infringing materials and parts**

DESIGNERS, unless they have a clear knowledge of the law and also comprehensive information as to the markets in which their products will be sold and also those from which materials and parts are purchased, are peculiarly likely to lay their employers open to suits for contributory infringement. While, of course, some contributory infringement is perpetrated knowingly, in the hope that law suits will be avoided or beaten, a large number of these offenses are inadvertent and result from ignorance.

It is contributory infringement to sell a device which the seller knows will be used as part of, and is especially fitted for a patented machine, or to perform a patented process, even though the device itself is not patented. The test is whether there was intent on the part of the seller to cooperate in the infringement. There are exceptions in the case of supplying repair parts which can, under certain conditions, be sold legally.

It is also contributory infringement to buy parts or materials from a concern which, in making them, is directly infringing a patent.

It is not contributory infringement to sell a device, say an electric motor, which is part of a manufacturer's standard line, provided it is done without knowledge that it is to be used as part of an infringing piece of equipment. But here is where the design department comes in. If it makes the slightest change in the motor, such as providing it with special bolt holes to enable it to be used with the infringing combination, the supplier's case would be much weakened, especially if the design department had been furnished with drawings of the equipment on which the motor was to be used.

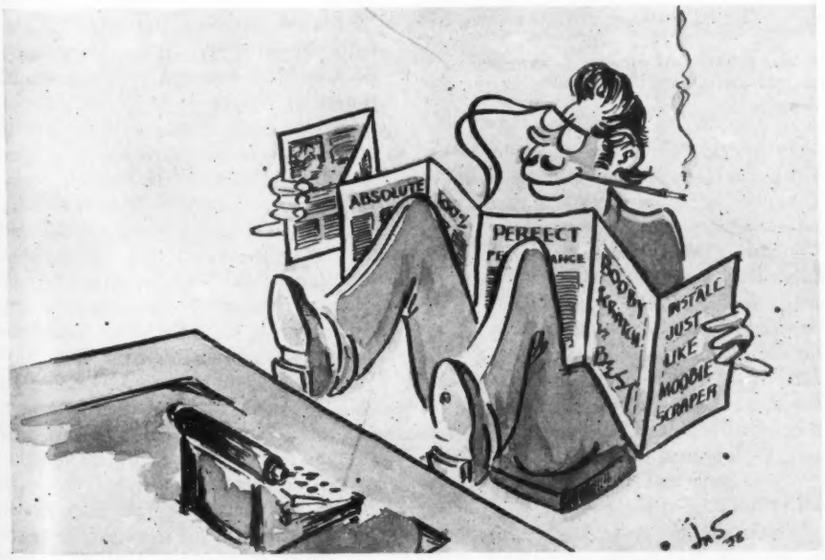
Even so, however, if the supplier could prove that he did not know that the equipment infringed a patent, he would probably be absolved from the contributory infringement charge. But, although the courts have held that the supplier is under no compulsion to determine whether the equipment for which he is supplying a part infringes any patents, it is the part of wisdom to have one's patent attorney look up the matter. It is expensive and annoying to be sued, even if the defense wins.

There is a rather famous case in which it was held that there was no contributory infringement on two grounds. Westinghouse sued Bullock Electric & Manufacturing Company for contributory infringement in supplying a motor to a Canadian manufacturer to be used as an element in the combinations covered by certain claims in the Tesla patents. Tesla's first two patents were for combinations. His motor was the essence of the inventions covered by these claims but he had neglected to claim the motor as a separate device and so abandoned any claim to it, per se, only claiming it as a part of one or another of his combination claims. The court said, in part:

### *Elements of Patented Devices*

"The monopoly of the patents did not extend to Canada. The patented devices were open to be there made or sold or used because the monopoly of the patent is limited to the United States and its territories. Unless, therefore, the making and selling of a single element of a patented device, within the limits of the United States, with the intention that it shall be sent without the United States, and there used in association with the other elements of the combination, constitutes infringement, the defendants did not disobey the order of the court. But unless the making and sale of the single element was with the intention and purpose of aiding and abetting another to infringe, there would be no contributory infringement under the well-settled law upon that subject. . . . It would not be an infringement to put the motor to the use intended, because that use was beyond the protection of the patent. The defense is as complete as if the intent had been to furnish the motor to one having a license to make, sell and use. In neither case would there be an intent to assist in an infringement, and without such intent (he) was not infringing the patents. . . ."

Here is another case involving design. Modine owned a patent relating to heating units for large halls, shops and the like. The new and useful results secured by this invention were, in the court's language, ". . . due to the method in which the combination of old elements




*Statements made in advertising copy or bulletins some times constitute damaging evidence of promoting contributory infringement*

as a whole, is installed, and not to any new function of any of the old elements themselves."

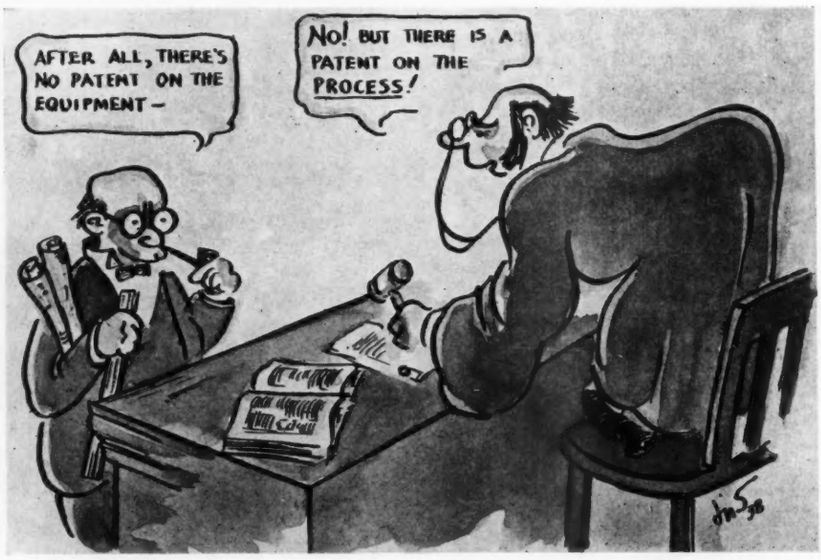
When Modine sued Young for infringement, the Circuit Court of Appeals found that Young's heating units could be installed in either an infringing or a non-infringing way. According to the law a manufacturer, in such a case, is guilty of contributory infringement only if he materially contributes to the installation or use in an infringing manner. One way of falling into such contributory infringement is by making statements in advertising, or in bulletins, which suggest the installation in an infringing manner.

The Young Company contended that it neither manufactured nor sold any fittings with which to install its structures and that it had nothing to do with their installation. But it was found that until a short time before the Bill of Complaint was filed, one of the Young bulletins ". . . suggested and urged the installation and use of (Young's) device in such a manner as to secure the same results,

"It is true that you have not infringed any machine patent. But the only profit which can be made out of a process is in its practice. . . . Therefore anyone who knowingly assists another to practice a patented process is just as much an infringer as the person who actually practices the process unlawfully. Accordingly we find that you are a contributory infringer. . . ."

Again, there was a patent on a process for making beer but none on the combination of equipment for practicing the process. When a manufacturer supplied a filter to be used with the equipment, knowing that the filters would be used for infringing the process, the court held that he had cooperated in bringing about the infringement of the process patent and was therefore a contributory infringer.

It is perfectly legal to supply ordinary repair parts to a patented machine so long as the repairs do not amount to practical reconstruction of the machine. Because the line between what constitutes




*Anyone who knowingly assists another to practice a patented process is as much an infringer as the person who actually practices the process unlawfully*

and by the same means, as those used by (Modine)."

A short time before suit was filed this statement was omitted from Young's bulletin, but not before that bulletin had 'started a very damaging force in motion, which was found to be hurtful to (Modine)." The court found that Young's conduct made him liable for contributory infringement.

Even though equipment for processing a product be not patented, a concern which sells the equipment, or a part of it, is a contributory infringer if the process itself is patented. In one case the court ruled against the manufacturer of such a piece of equipment in substantially the following words:

reconstruction and mere repair is finely drawn it is risky to enter into the business of supplying repair parts without first consulting a patent attorney.

A case in point had to do with a combination of several parts, including patented locks, which were part of a patented railway car coupler. When railway companies purchased locks to replace those broken in use, the courts held that the act constituted contributory infringement. It was, the court said, not mere replacement and repair but in degree was sufficient to be reconstruction and rebuilding of the coupler.

It is sometimes submitted—quite correctly—that because it is difficult and expensive to make a repair, the only practical thing to do when a part breaks or wears out, is to replace a considerable portion of the device. The courts have held that, regardless of the truth of this contention, the practice nevertheless is against the law.

It should go without saying that the manufacturer of an infringing device cannot legally supply repair parts for the device. Yet one manufacturer of a shock absorber, who had been manufacturing it for years, in spite of the fact that he was all of the time infringing another's patent, tried many devious plans, after he was forced to stop the manufacture of the shock absorber, to continue selling repair parts for it.

None of his efforts to find a loophole worked, and the court said: "You cannot manufacture and sell repair parts. If you did, you would be continuing the infringement and contributing to it, because every user of the shock absorber is just as much an infringer as you are. It is an infringement to make the shock absorber, to sell them, or to use them. It is an infringement to furnish a substantial portion of the absorber as a repair, because you would be knowingly helping another to continue the infringement, or perpetuate it. Anyone who cooperates to make the infringement possible is a contributory infringer."

### *Buying Parts or Materials*

Now, as to buying parts or materials from one who is infringing a patent. The classical case is that of DeForest and Mallory. Coolidge owned a patent for a process of making tungsten wire. Mallory made this wire under a process which infringed the Coolidge patent. However, he made it of only a certain size.

DeForest made vacuum tubes, part of which consisted of a tungsten wire filament. He bought it from the infringer, Mallory. DeForest was sued as a contributory infringer. His defense was that he bought it innocently in the ordinary course of business.

But the plaintiff was able to show that Mallory made the wire up in a special size for DeForest, at DeForest's request, and that as a result DeForest bought large quantities of it regularly. This indicated to the court that the purchases were not casual, such as might be made by any customer who was unaware of the infringement, and therefore constituted contributory infringement.

I want to emphasize, by repeating, that while the court does not hold it to be the duty of a buyer or seller to investigate whether the material or device bought is an infringement, or whether the device sold is to be used for an infringement, the safe thing to do is to get the advice of a patent attorney and find out the facts before taking any chances.

# Question and Comment

## Motor Spring Design Charts

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Formulas for spiral springs which are used to drive mechanisms of clocks, recording instruments, and gramophones are based on several fundamentals, a proper combination of which will give the best utilization of the space available, and secure the required shaft or barrel revolutions. The principal notations used in developing the following formulas are:

$n$ number of turns in the spring when fully wound

$n_1$ number of turns when the spring is unwound, having a certain initial preloading

$N$ number of revolutions of the shaft or barrel specified $N = n - n_1$

$n_0$ number of turns in the spring when free, ranging from 5 to 9

$D$ inside diameter of the barrel in inches

$d$ diameter of the shaft or arbor in inches

$l$ theoretical length of spring steel, in.

$t$ thickness of flat steel in inches. Birmingham wire gauge standard thicknesses are used

$W$ width of flat steel in inches

Select ratio $\frac{d}{t} = C$ and $\frac{D}{d} = b$; the fundamental equations are as follows:

$$n = -\frac{C+1}{2} + \sqrt{\left(\frac{C+1}{2}\right)^2 + \frac{l}{t\pi}}$$

$$n_1 = \frac{Cb-1}{2} - \sqrt{\left(\frac{Cb-1}{2}\right)^2 - \frac{l}{t\pi}}$$

$$T_m = \frac{E\,w\,t^3\pi\,(n-n_0)}{6l} = P \times 0.5\,D$$

$$T_1 = \frac{E\,w\,t^3\pi\,(n_1-n_0)}{6l}$$

$$P \times 0.5d = \frac{wt^2}{6} \times$$

In the above equations, $T_m$ is the maximum torque in in.-lb., which the spring is theoretically capable of exerting.

$P$ is the tangential force in lb. applied to the drum or barrel.

$T_1$ is the initial torque (preloading) in in. lb.

It may be pointed out that the relationship between $T_m$ and $T_1$ governs the barrel or shaft revolving speed variation during the spring unwinding. With 40 to 50 per cent fall in torque, speed variation is about 0.6 per cent.

At 20–30 per cent fall in torque, variation is 1 per cent. To secure a constant speed in unwinding (as in gramophone motors), centrifugal governors must be employed.

$E$ is the modulus of elasticity of spring material, assumed 28,000,000 lb. per sq. in. for steel.

$f$ is the permissible fiber stress in lb. per sq. in. equal to the ultimate tensile strength of material divided by the factor of structural safety. The ultimate tensile strength of clock spring steel ranges from 230,000 lb. per sq. in. (for 0.08 in. strips) to 290,000 lb. per sq. in. (for 0.004 in. strips). Using factors of safety 3.5 to 4 respectively, the reasonable mean value of permissible fiber stress $f$ will be 70,000 lb. per sq. in.

The accompanying charts enable the designer to establish proper sizes of spring material used and the length capable of developing the torque.

Example I. A spiral spring suitable

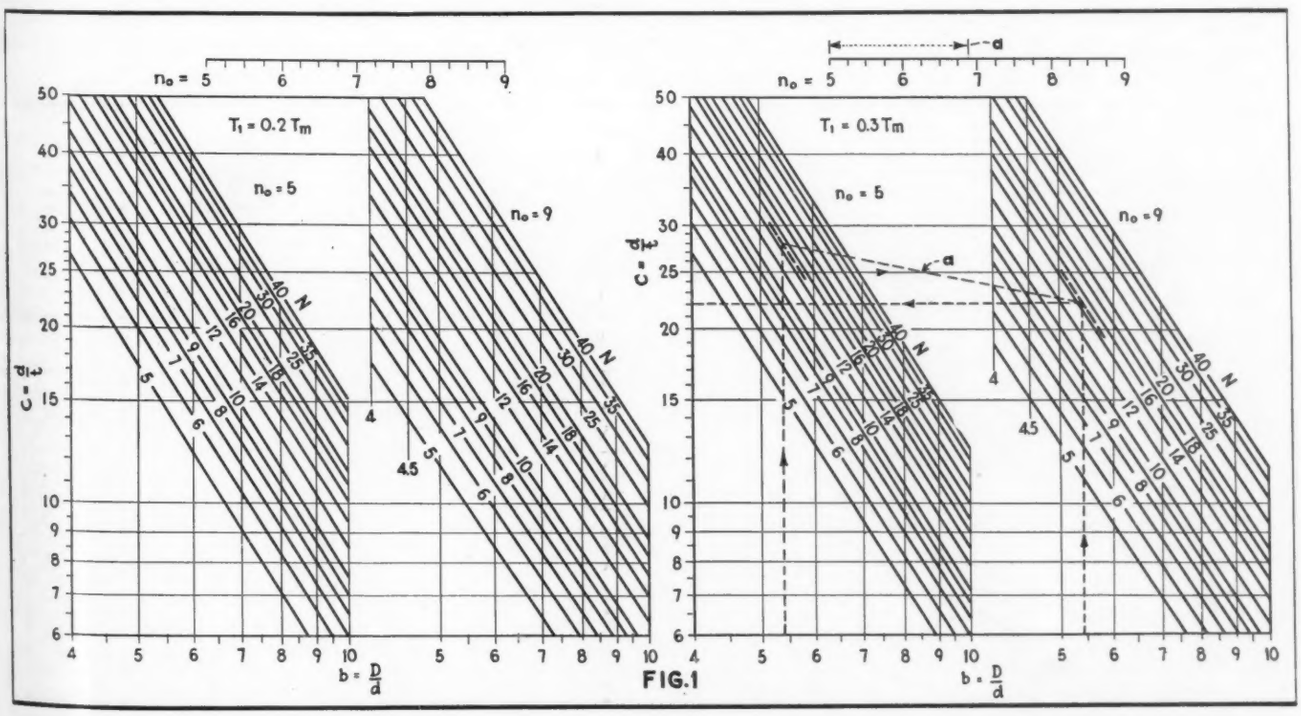



FIG. 1

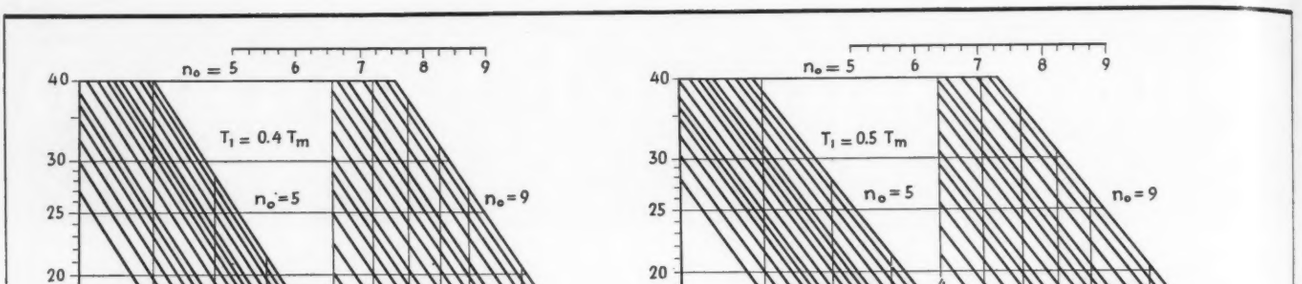



FIG. 2

for a gramophone mechanism. The number of revolutions of the spring barrel is fixed at $N=15$. The following restrictions are to be observed: the inside diameter of the spring barrel $D = 3\frac{3}{8}$ in., diameter of shaft $d = \frac{5}{8}$ in.

The minimum torque necessary to overcome the resistance torque of the motor mechanism is equal to 9 in. lb. Selecting the efficiency of the spring unwinding 0.7, the theoretical minimum torque $T_1 = \frac{9}{0.7} = 12.9$ in. lb. With 0.8 per cent allowance for speed variation, the theoretical maximum torque $T_m = \frac{T_1}{0.3} = 43$ in. lb. Using the chart Fig. 1, constructed for $T_1 = 0.3\ T_m$ and $n_o = 9$, from the point in the bottom scale designating ratio $b = D/d = \frac{3\frac{3}{8}}{\frac{5}{8}} = 5.4$ trace vertically to the sloping line representing $N = 15$. Then trace horizontally from this point to the left hand vertical scale, which indicates $C = \frac{d}{t} = 22$. Thus $t = \frac{d}{22} = 0.028$ in. To estimate length of spring steel $l$ and number of turns in the spring when fully wound $n$ use the chart, Fig. 3. From the point in the top scale designating ratio $\frac{N}{b} = \frac{15}{5.4} = 2.78$ trace down vertically to the sloping line representing ratio $\frac{T_1}{T_m} = 0.3$. Then trace horizontally from this point to the left hand vertical scale, which indicates ratio $l/t = 5150$. Thus, $l = 5150 \times 0.028 = 144$ in. The length of strip including the end fixtures will be: $1 + 4d = 144 + 4 \times \frac{5}{8} = 146\frac{1}{2}$ in.

With the same graph, Fig. 3, the number of turns $n$ can be obtained. Trace horizontally from the point in the left hand scale designating $l/t = 5150$ and vertically from the point in the bottom scale designating $C = 22$. The intersection of both lines thus found will indi-

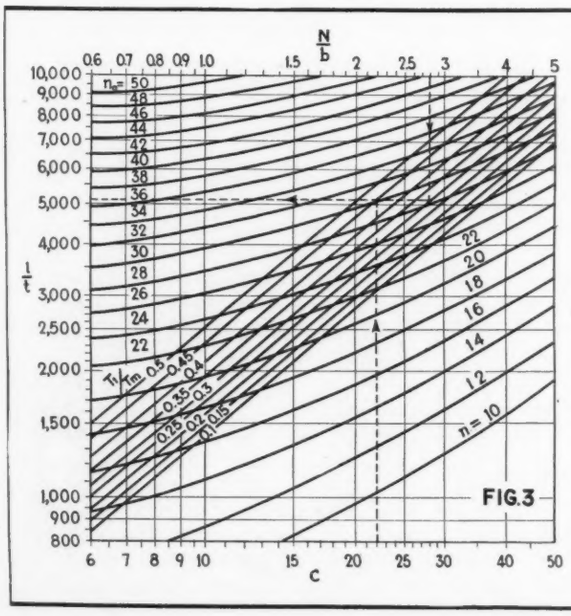



FIG. 3

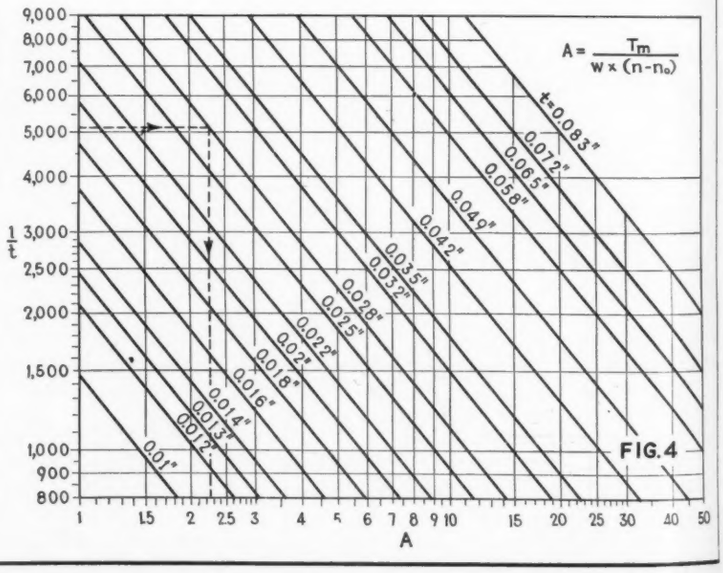



FIG. 4

cate a corresponding sloping line for $n = 30$.

The chart in Fig. 4 enables the designer to estimate the width of spring steel. From the point in the left hand vertical scale designating $\frac{l}{t} = 5150$ trace horizontally to the sloping line representing $t = 0.028$ in. Then trace vertically from this point to the bottom scale, which indicates value of $A = \frac{T_m}{W \times (n-n_o)} = 2.26$ thus $W = \frac{43}{2.26 \times (30-9)} = 0.908$ in.

Example II. A spiral spring similar to above, but coiled from 0.025 in. steel strip. The number of turns in the spring when free can be estimated from the graph in Fig. 1 constructed for $T_1 = 0.3\ T_m$.

From the point in the bottom scale designating $b = 5.4$ trace vertically to the sloping lines representing $N = 15$. Through the point of intersection thus obtained trace a line which intersects the horizontal line, traced from the point in the left hand vertical scale designating $C = \frac{d}{t} = 25$. at the point "$a$." The horizontal distance of the said point from the vertical line traced from the point $b = 5.4$ in the graph constructed for $n_o = 5$ will give in the top additional scale the value of $n_o = 7$. Proceeding as before, we obtain from the chart in Fig. 3 value of ratio $\frac{l}{t} = 5150$, $l = 5150 \times 0.025 = 128.7$ inches and $n = 29$.

Finally from the chart Fig. 4 we estimate $A = 1.84$ and $W = \frac{43}{1.84 \times (29-7)} = 1.06$ in. for the spring width.

## Raising the Modulus of Cast Iron

*To the Editor:*

From certain reliable sources we were informed that a high strength iron, say 45,000 to 50,000 lb. per sq.in. tensile, would have a higher modulus than the ordinary 25,000 to 30,000 lb. per sq.in. tensile iron. We have been informed that, should we keep the stress in the member low in relation to the ultimate strength of the cast iron, it would be safe to use a higher modulus in figuring deflections. To illustrate: Should a 45,000 lb. per sq.in. tensile iron be used and the member stressed to 1,000 lb. per sq.in. we might add anywhere from 25 to 50 per cent to the modulus.

All this information was gathered from various round table discussions approximately a year ago, and we find that in more recent months the sources from which this information was obtained are not "sticking quite so closely to their guns." We would therefore appreciate comments from various sources who might be interested in this same problem.

This whole situation might be summed up briefly with the following questions: How can one raise the modulus of elasticity of cast iron commercially, and what might be expected as a modulus if it were done?

—E. W. CLEM
*Worcester, Mass.*

## Centrifugal Castings vs. Forgings

*To the Editor:*

In the July 1938 number of *Product Engineering* on page 242 to 244 in the article on centrifugal castings, the author said on page 243, paragraph 3:

"Centrifugal casting has been used to make blanks for transmission, cluster gears and ring gears of steel and has been found to result in stronger, lighter and less expensive gears than those produced by conventional forging methods."

We make a product (Rock Bit Cutter) which is very similar to a gear and are very interested in making this product as strong as possible. For some time we have made this product exclusively from forgings and have considered a forging to be much stronger than any type of casting. If centrifugal castings have been found to be stronger for gear construction, we have reason to believe that they might very well prove to be stronger for our cutter construction. However, we have reason to doubt the statement that centrifugal castings are stronger than forgings for this type of work.

We would greatly appreciate an opportunity to investigate the data, and tests which were made, which enabled the author of this article to arrive at such conclusions, so that we might examine these data and see if they would be applicable to our cutter construction as well as to gear construction. Will you please let us know where we can get the information and data which caused the author of this article to make the statement that centrifugal castings had been found to be stronger than forgings for gear constructions?

We would like to investigate centrifugal casting as a possible means of manufacturing our cutters and would like to have you send us a list of foundries which can make centrifugal castings of SAE 4815 steel. These castings would range in diameter from 3⅞ in. to 7⅜ in. and range in length from 1⅜ in. to 2½ in. and range in weight from 2¼ lb. to 15½ lb.

—GEORGE F. FERMIER
*Research Department*
*Reed Roller Bit Company*
*Houston, Texas*

[Editors Note: The author of the article on centrifugal casting is Mr. J. D. Zaiser of *Ampco Metal, Incorporated, 3830 West Burnham St., Milwaukee, Wis.* His company has a considerable amount of test data on centrifugal casting. Also, Mr. Arthur H. McCarroll, metallurgical engineer of the *Ford Motor Company, Detroit, Mich.*, has considerable unbiased data on this subject. *Ford* casts gear blanks centrifugally. According to Mr. McCarroll, centrifugal casting not only insures a sound casting, but the structure of the casting runs perpendicular to the line of action of the forces that come on the gears with the result that such cast gears are stronger than forged gears wherein some of the flow lines run parallel with the load. It is this which makes the centrifugal cast gear stronger, rather than the inherent physicals of the metals. *Campbell Wyant and Cannon Foundry of Muskegon, Mich.*, also make centrifugal steel castings and have also accumulated a large amount of data.]

# *Can You Work This One?*

H. E. SMITH

*Solution to Last Month's Problem—*

### *Flagpole, Rope and Stone*

If $x$ is the length of the rope which will reach from one flagpole top 130 ft. high to a second flagpole top 110 ft. high, both standing on a level plane, and which will also reach from the top of either pole to the stone which lies on the line joining their bases, then, by geometrical relation, the following equation can be obtained:

$x^4 - 57{,}200\ x^2 + 817{,}960{,}000 = 4x^4 - 116{,}000\ x^2 + 817{,}960{,}000.$

Whence $x^2 = 19{,}600$ and $x = 140$ ft. length for rope.

*This Month's Problem—*

### *Animal Auction*

A farmer purchased 100 animals, cows, pigs and chickens, at an auction, for exactly $100. The bargain prices were $10 for each cow, $3 for each pig and 50 cents for each chicken. How many of each animal were purchased?

# PLUGS, CAPS AND

**Additional methods of plugging or covering oil holes and other necessary access or core holes in machinery. Twenty-three typical methods were illustrated and described last month**

H. J. MARTIN

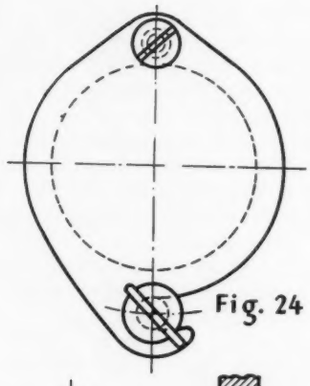


Fig. 24

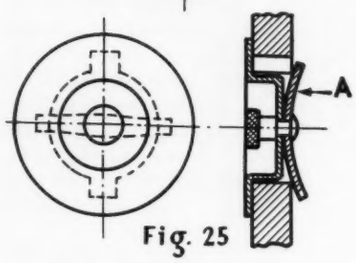



Fig. 25

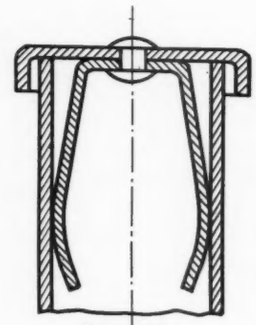


Fig. 26

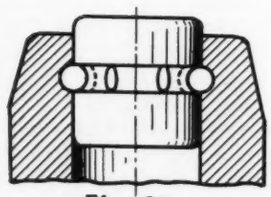


Fig. 27

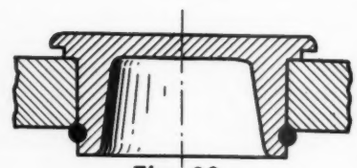


Fig. 28

Fig. 29

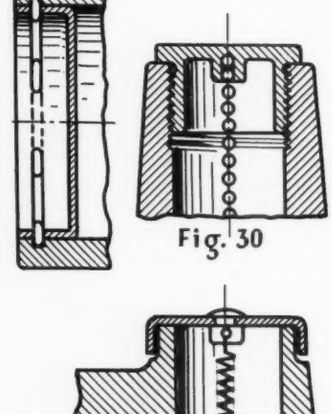
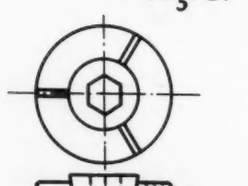


Fig. 30



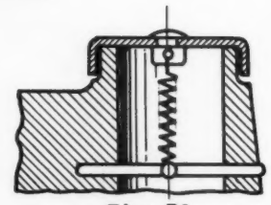


Fig. 31

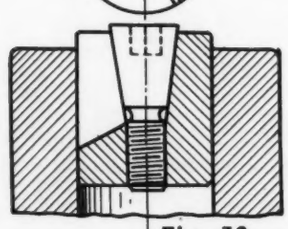


Fig. 32

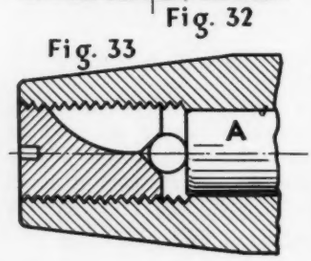



Fig. 33

Fig. 34

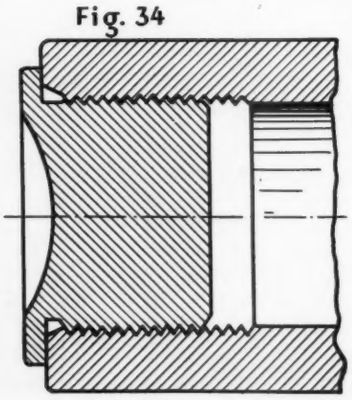


Fig. 24—Heavy cover for observation opening or cleaning hole. End opposite pivot screw is hook-shaped and engages thumb screw for locking.

Fig. 25—Another type of cover for large holes. Flat spring *A* of sufficient stiffness is keyed and riveted to knurled finger knob. Casting is slotted for entrance as shown in end view. Dished cover can be made to fit any shape of hole.

Fig. 26—Sheet steel cover for closing tube or pipe. A long piece of narrow flat stock, not necessarily spring steel, is shaped as shown and riveted to cover. Spring width is formed greater than inside diameter of tube and cams to retaining position when pushed into hole.

Fig. 27—Snap-spring lock for any size of hole plug. Depth of groove in casting is turned approximately 1/3 diameter of wire for disassembly. Groove in plug is sufficiently deep for contraction of snap-ring during assembly or removal of plug. Spring length is approximately 80 per cent on one complete coil.

Fig. 28—Method of retaining cast iron plug in hole. Inside of hole is chamfered into which snap ring partially fits. If ring is strong enough, it tends to creep up the chamfer incline, thereby assuring proper contact between surface and plug.

Fig. 29—Large dished cover held in place by wire snap-ring. Cover is slotted as shown in end view to accommodate the two ears formed into the snap-ring. These projections engage the continuous groove in the casting. To facilitate removal of retaining spring, the ends are looped at *A* for engagement of pliers.

Fig. 30—Screw plug has ball chain attached to center inside boss so plug cannot be misplaced. Cover can be turned without kinking ball chain, the latter being long enough to allow removal of plug. Other end of chain is fastened to inside casting.

Fig. 31—Pin with hole is riveted to sheet metal cover. Loop of helical spring engages hole in spring. Lower spring loop is slid over retaining pin in casting. Upon removal of cap, lower spring loop slides along pin towards wall of hole.

Fig. 32—The smooth plug with either three or four slots has the outer end taper-reamed for a special heat-treated socket head screw. Short plugs that cannot be slotted to sufficient depth should have a good fit in hole before expansion takes place.

Fig. 33—Straight fine-threaded plug is slotted as in Fig. 35. The inner end is taper spotted and acts as ball seat. The steel ball bears against member *A*, expanding plug in hole threads.

Fig. 34—Threaded plug with low flanged head for plugging end of spindle to prevent coolant drip. Flange is circular slotted so that head may be kept as short as possible.

Fig. 35—Unthreaded plug to take place of that shown in Fig. 37. Saves tapping. Plug is cross-drilled for steel pin, the end of which is beveled to engage cone-pointed headless set screw.

# COVERS–II

Fig. 36—Another plug for same installation as in Fig. 38. Cross hole is not quite drilled through plug, and forms seat for ball. Pin-retained spring pushes ball into turned groove in spindle.

Fig. 37—Plunger pin is used instead of ball. Plug is drilled and reamed but not completely through. Plunger end is turned down and retained by inserted washer. Spindle has drill spot for engagement of plunger end. Hole in spindle is plugged at *A*.

Fig. 38—The flanged plug is tapped off center for a cone pointed headless set screw which pushes the locking ball into the groove in the casting. When removing plug, screw is backed out partially, the ball falling into the drilled pocket. Should be assembled with ball uppermost to prevent loss of ball when plug is removed.

Fig. 39—Two hemispherically headed drill rod pins with opposite ends beveled for screw engagement. Pins fit in V-groove in casting. When screw is backed off, pins will cam in towards center for removing plug from hole.

Fig. 40—Oil level sight gage in which steel plate *A* has two drilled holes for oil and air circulation. Two cork gaskets, one each side of glass disk, are retained by flanged cover.

Fig. 41—Similar arrangement as Fig. 43, except that circulation holes are drilled directly in casting wall, thereby eliminating one piece. Retaining collar is set into counterbored hole for better appearance.

Fig. 42—Oil drip gage inner member has oil-collecting channel *A* which catches oil running down inside wall of housing. Oil runs through inclined tube past glass window. Cork gaskets, glass and channel member are retained by collar fastened to outside of housing.

Fig. 43—Commercial type of oil sight gage is integral and purchased ready to assemble. The brass housing with hex.-shaped periphery to facilitate assembly is counterbored for two cork gaskets and glass disk. A metal washer *A* rests against outer cork gasket. The brass housing is then spun over onto this metal washer, making the assembly oil-tight.

Fig. 44—When a mechanism projects past the outer wall of a machine part, a tubular piece with closed end can be used. At *A*, the housing is expanded as shown in the end view, entering cross slots in hole and then turned 90 deg. to assembled position. Collar *B* is completely circular and acts as a locating flange.

Fig. 45—A similar type of tubular housing except that both flanges *A* and *B* are completely circular. The open end is slotted, and made of springy material, will contract sufficiently when entering the hole, and expand to a locking position when flange *A* reaches inner wall of housing.

Fig. 46—Sometimes a spring must extend through the wall of a casting. To house the spring, a commercial flanged tube with closed end is used. Assembly with flange against inner wall of housing is kept in place by resulting spring pressure.

Fig. 47—A copper bellows can be used when there is a variation of pressure from within. The threaded portion is spun over into the groove between the first two convolutions. When assembled, the threaded tube is screwed tightly against the first convolution to make a leak-proof joint. This bellows is a commercial product and has other possibilities as a hole covering.

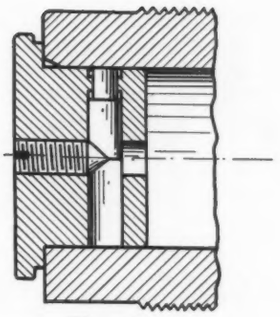


Fig. 35

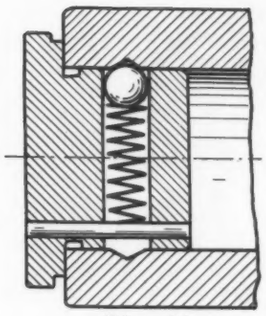


Fig. 36

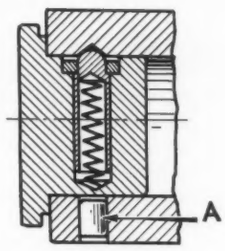


Fig 37

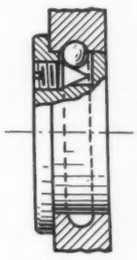


Fig. 38

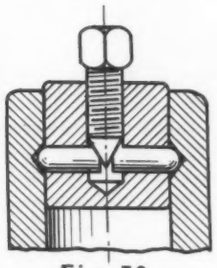


Fig. 39

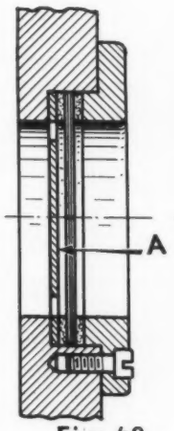


Fig. 40

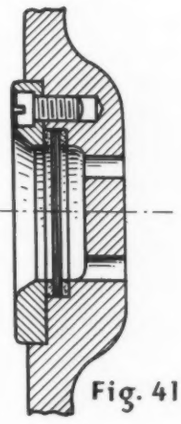


Fig. 41

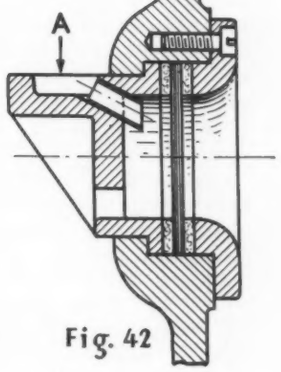


Fig. 42

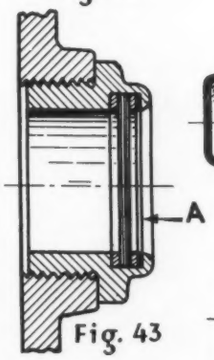


Fig. 43

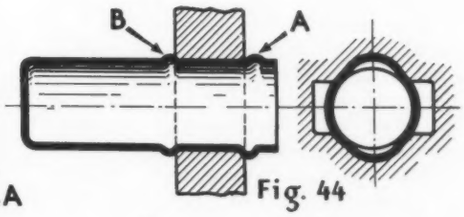


Fig. 44

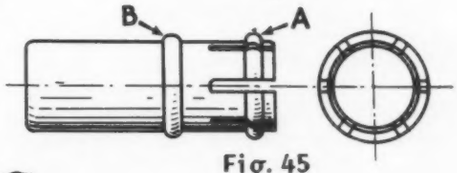


Fig. 45

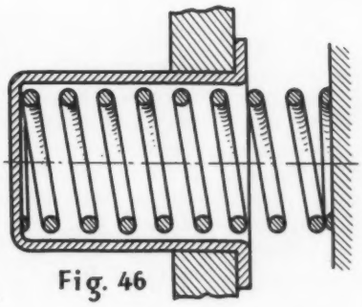


Fig. 46

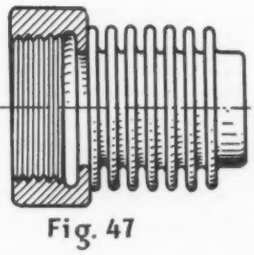


Fig. 47

# News

## *Owens-Corning Corporation To Manufacture Glass Textiles*

THE WIDESPREAD application possibilities of fiber glass in the fields of insulation, construction and mechanical design is indicated by the formation of the Owens-Corning Fiberglass Corporation, sponsored and financed jointly by the Owens-Illinois Glass Company and Corning Glass Works. The new corporation, which will produce a variety of products made from fiber glass, is the culmination of development work by the two parent companies involving about $5,000,000 total expenditures.

Smaller and lighter vacuum cleaners and other home appliances using motors were forecast by exhibits displayed at the Waldorf-Astoria Hotel. Glass insulated stoves and refrigerators which will save gas and electric current; homes insulated with fiber glass, warmer in winter with less fuel consumption, and cooler in summer; fiber glass much superior in several respects to other materials for the winter protection of plants and shrubs, were among the present commercial applications of the product in the display. Fiber glass separator plates were shown which make possible storage batteries producing substantially greater power with longer life than batteries employing other types of separators. These batteries, together with more compact generators using the new material, are expected by the company to have an important effect upon automotive design, as the modern automobile makes continually greater demands upon its electrical system.

These new products, representing the pioneering efforts of Owens-Illinois Glass Company and the Corning Glass Works working cooperatively on both research and development, have made possible an entirely new industry, according to Mr. Boeschenstein, president. The industry was depression born, the basic idea having been conceived, the vast amount of experimental work carried through, and the necessary machinery and processes perfected in the last seven years. By merging efforts in a single jointly-owned company, more economical development of the various present and potential products will be possible.

The facts as given by Mr. Boeschenstein reveal a story of the hundreds of laboratory experiments and tests over the past three years in the development of the new material. Glass suitable for other purposes was found to be unsuitable for drawing and spinning into silk-like threads for electrical insulation and glass fabrics, such as insulating tapes and chemical filter cloths. A new type of glass is now being drawn into fibers two ten-thousandths of an inch thick, and may be drawn much finer than any commercial organic fiber or the finest spider web.

Fiber glass insulation will permit of substantial overloading of electro-magnetic devices without damage to the insulating materials. Electric motors of a given horsepower using fiberglass insulation are more than one-third smaller than those using other insulating materials. Pipe covering for high temperature and refrigeration lines, fiber glass blankets for steam turbines which operate at the maximum practical temperatures without damage, sound insulation for airplanes and other structures, and air filters are among the developments announced.

## *New Instruments and Controls at Power Show*

THE Thirteenth National Exposition of Power and Mechanical Engineering will be held in New York Dec. 5–9 and will present to industrial engineers and executives recent developments in the field of power and mechanical engineering. The last National Power Show in 1936 had 39,000 registered guests, and this year an even greater attendance is expected. More than 270 exhibitors already have reserved space.

Instruments and controls will be featured in many exhibits. Magnetic liquid level gauges for atmospheric and pressure tanks up to 400 lb. pressure will be demonstrated. The safety feature of these gauges is important, especially in connection with liquid stored under pressure. It is claimed that an absolutely tight job is made possible by the magnetic action, together with the use of a brass forged head. Even if the glass crystal and dial are shattered by a sharp blow, no liquid leakage can develop.

A manufacturer of electrical safety switches, panelboards and switchboards will show a new duct system of electrical distribution. Every inch of this system is a potential outlet into which lighting fixtures or electric power appliances can be plugged for instant current. Suitable trolleys or plugs are provided for this purpose, in addition to the duct system.

Industrial testing machine exhibits will feature a machine with a high magnification recorder. Radio tubes register changes in length on a test bar, and chart this in relation to load; also an electric balancing machine determines the amount of unbalance in a rotating body, and meters this electrically. A complete line of manual, semi-automatic and automatic a.c. and d.c. starters, speed regulators and accessories will also be displayed. The a.c. motor starter is said to be a radical departure from the conventional design of magnetic motor controls. Electronic type voltage regulators and adjustable ratio autotransformers for controlling lamp brilliancy likewise will be offered.

The hose and tubing section of the Power Show will show a wide variety of appliances and demonstrate equipment use by means of operating displays. The correct way to install metal hose and tubing to obtain longest life at lowest cost will be shown by one exhibitor, and this presentation will include the type of seamless, flexible bronze tubing now in use in Ford's new tire factory. Another exhibit will demonstrate the ability of an all-metal pressure tubing to absorb vibration and movement while carrying liquids and gases under pressure. A complete new line of stainless steel bellows, on display for the first time at this year's Exposition, will be shown. The stainless steel sheets, 0.004 in. thick, are first formed as a straight welded tube and then corrugated into bellows to permit various types of motion. Detachable couplings and self-flaring copper tube couplings also will be shown.

Power transmission appliances will be the subject of many important and comprehensive presentations. A "friction-ized" belting, which is claimed to deliver maximum load immediately, and, according to reported transmission tests, to maintain that capacity beyond the ordinary "breaking-in" period will be displayed. One display will feature built-in high-speed and low-speed units which demonstrate a compact combination of speed variation and reduction. Other complete lines of transmission equipment will include V-belts, round and flat endless belts, belt fasteners, indus-

trial hose, silent and roller chain drives, worm and motorized helical gear reducers, anti-friction pillow blocks, flexible couplings, variable speed units, standard and over-running clutches, speed control units, sprocket wheels.

## *Lincoln Arc Welding Awards Total $200,000*

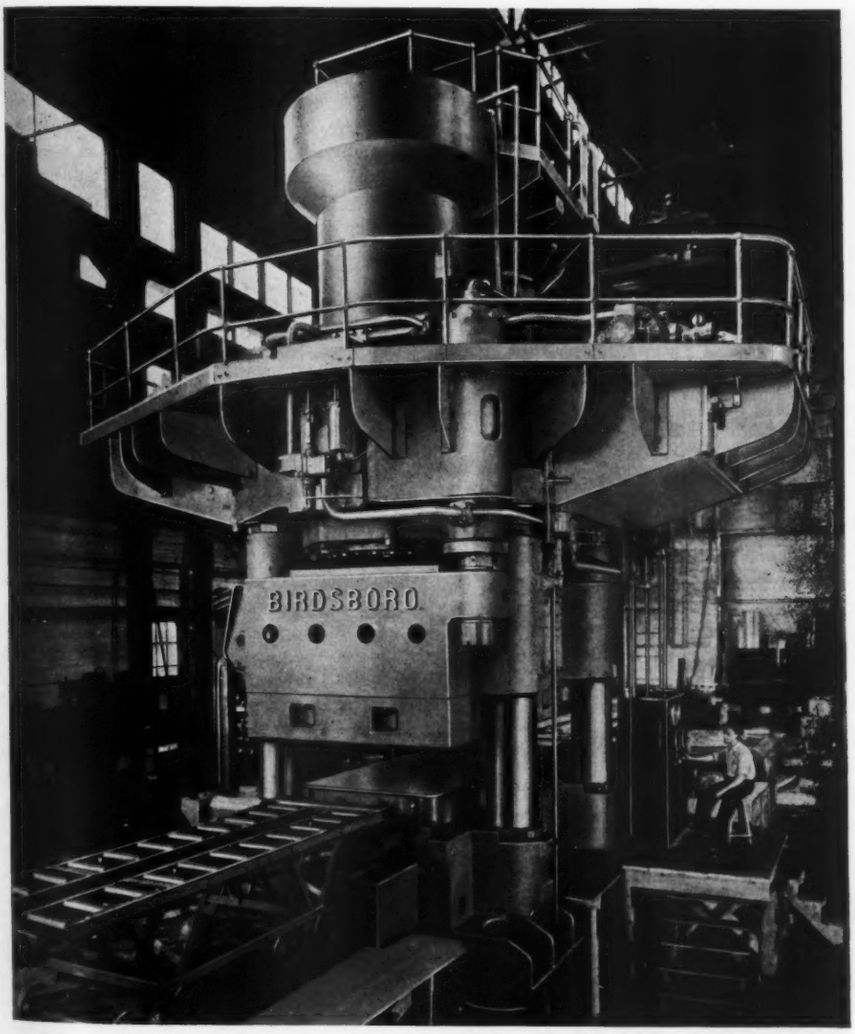
THREE hundred and eighty-two awards, ranging from $100 to $14,000 and totaling $200,000, were distributed by the James F. Lincoln Arc Welding Foundation for papers submitted in the arc welding competition. The grand award went to Mr. and Mrs. A. E. Gibson of the Wellman Engineering Company of Cleveland for their paper on "The Commercial Weldery."

"Industrial Machinery, Steel Making," by Robert E. Kinkead, consulting engineer of the Carnegie-Illinois Steel Company received the second highest award. L. J. Carey and Marvin Whitlock of American Airlines, Incorporated, received third award for the paper "Weld-Aircraft Piping." The program, begun eighteen months ago, was judged by 31 engineering authorities from leading universities throughout the United States.

## *A.S.M.E. Annual Meeting*

PRESENTING the latest developments in the fields of machine tools, steam power, aeronautics, management, safety, metals, fuels, hydraulics, lubrication, and research, the fifty-ninth annual meeting of The American Society of Mechanical Engineers will be held at the Engineering Societies Building in New York City, December 5–9, 1938.

Among the papers to be presented at the meeting will be "Modern Hydraulic Units for Machine Tools," by K. R. Herman; "The Application of Hydraulics to Machine Tools," by Paul Jackson; "Progress Report on Creep Tests of Tubular Members"; "Some Observations on Yield Point of Low-Carbon Steel," by Joseph Winlock and R. W. E. Leiter; "Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs," by A. M. Wahl; "The Effect of the Speed of Stretching and the Rate of Loading Upon the Yielding of Mild Steel," by E. A. Davis; "Deflection of Helical Springs Under Transverse Loadings" by W. E. Burdick, F. S. Chaplin and W. L. Sheppard.




*The world's largest hydraulic press, designed for the shearing and forming of airplane parts and built by the Birdsboro Steel Foundry and Machine Company. It has a platen area of 200 by 90 in., a 54-in. stroke, and can exert a working pressure of 5,500 tons. Operation can be automatic or manual as desired; and the press is equipped with synchronized transferring means for loading the work into, and simultaneously removing the finished work from, the press*

## MEETINGS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—*Annual Meeting, Engineering Societies Building, 39th St., New York, N. Y., December 5-9. Secretary, C. E. Davies, 29 W. 39th St., New York, N. Y.*

SOCIETY OF AUTOMOTIVE ENGINEERS—*Annual Meeting and Engineering Display, Detroit, Mich., January 9-13, John A. C. Warner, secretary and general manager, 29 W. 39th St., New York, N. Y.*

## EXPOSITIONS

THIRTEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING—*Grand Central Palace, New York, N. Y., December 5-10. Further details can be obtained from Charles F. Roth, president of the International Exposition Co., Grand Central Palace, New York, N. Y.*

## *Do You Know That—*

VACUUMS SO HIGH that they cannot be measured with existing gages have been produced by a new technique and equipment recently perfected. The machine has no moving parts consisting only of electric wiring and glassware. (96)

PIC'S BRISTLES for tooth brushes are being supplanted by a new synthetic material which has three times the wear resistance. The same material also promises to make excellent stockings superior to rayon in wear and appearance. (97)

AN ELECTRONIC MICROSCOPE has been invented which, without lenses, magnifies up to 20,400 times, and gives 25 times the resolving power of the best conventional lens-type microscope. If this principle were applied to a telescope, it would have a power equivalent that of one with a 2,000 in. diameter reflecting mirror. (98)

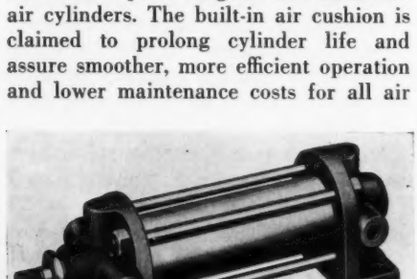
# New Materials and Parts

### *Bulb-Reflector Lamps*

Mazda lamps having reflectors inside the bulbs which are flared and coated on the inside of the flare with metal which has a high polish and directs the light of the filament in a powerful beam. Efficiency of the directed light is said to be high because the reflector has the accurate shape of a modified paraboloid and the filament is precisely positioned with relation to the focal point of its reflector. Lamps are rated 150 watts and are available for 110, 115 and 120 volt circuits. Available in two general types: Projector lamp made of heat-resisting glass, having a hard glass bulb to permit use out-of-doors with no damage to the bulb from water. Reflector lamp is designed for spot-lighting application, and due to the fact that it is made of soft glass it cannot be burned out-of-doors. Westinghouse Electric & Mfg. Co., Bloomfield, N. J.

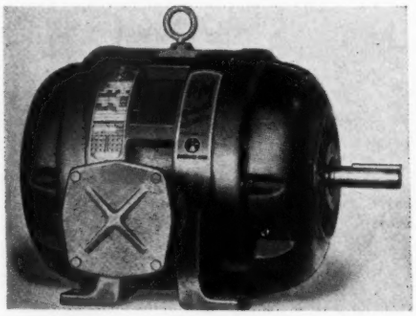
### *Cushioned Air Cylinders*

Complete line of air cylinders with non-adjustable cushion-heads, available in the same price range as non-cushioned air cylinders. The built-in air cushion is claimed to prolong cylinder life and assure smoother, more efficient operation and lower maintenance costs for all air powered equipment. Nopak air cylinders with adjustable cushion-heads are recommended for applications where accurate control of cushioning is required at the end of the piston stroke. Descriptive bulletin available. Galland-Henning Mfg. Co., S. 31st St., Milwaukee, Wis.



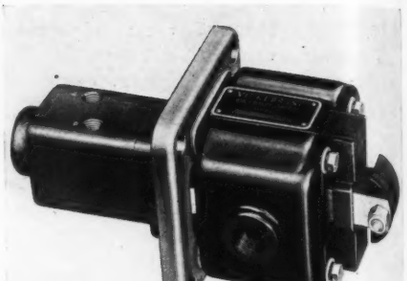
### *Explosion-Proof Motor*

Complete line of totally-inclosed explosion-proof motors in NEMA frames available in various electrical modifications for standard voltages and frequencies. Features include double-end ventilation, reversible conduit box, sealed cartridge type ball bearings. Bulletin 1225 available. Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.



### *Self-Lubricating Bronze*

A self-lubricating bearing bronze, known as "Ledaloyl," which can be classified primarily as a sintered type. An exclusive process of pre-alloying is said to reduce all the basic metals to one definite alloy and create a uniform grain structure and a thoroughly homogeneous material into which lead is introduced. In the manufacturing process, a certain amount of volatile material is included that later gives the bearing a porous character. By submersion in vacuum tanks these pores are filled with oil of a viscosity to suit the application and are said to retain up to 35 per cent of the oil by volume. The capillary structure of the bearing permits a constant flow of oil to the shaft when needed and absorption when not in use. The combination of lead and graphite in the alloy, plus the oil content, produces a satisfactory self-lubricating bearing. Johnson Bronze Company, New Castle, Pa.

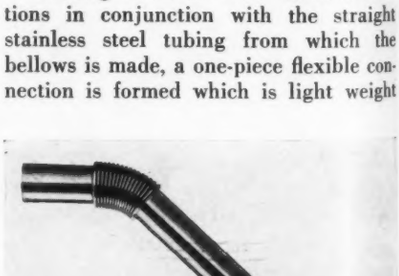


### *Four-Way Valve*

A line of solenoid operated four-way valves available in sizes from ½ to 2 in. pipe thread. There are several types: spring offset with a solenoid at one end only, spring centering to an open or closed center neutral position with a solenoid at both ends, and others having no internal control spring at all and carrying a solenoid on each end. The hydraulic valve itself is also available in several types to allow for various circuit requirements and some models are used for tandem operation where large back pressures are to be considered. In addition, there are types which are termed "gasket mounting" that mount directly upon drilled pads on the machine, thereby doing away with exposed piping connections. In addition there are two types of solenoids available, one type of which is air cooled and of the standard construction, the other being oil cooled and totally inclosed. Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

### *Flexible Connections*

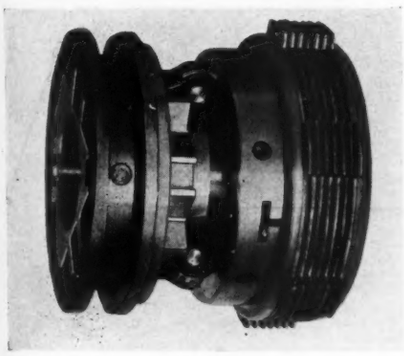
Utilizing stainless steel bellows sections in conjunction with the straight stainless steel tubing from which the bellows is made, a one-piece flexible connection is formed which is light weight



yet strong and highly resistant to action of corrosive gases and liquids. Corrugation may be made wherever required in the tubing length, permitting a wide variety of assemblies and applications. Metal braid as well as an overall guard may be applied for additional protection. Uses are for conveying corrosive fluids of all kinds, and for the resistance to high temperatures which stainless steel provides. Manufactured from 18-8 stainless steel by an exclusive process that assures uniform precision thickness of tubing wall. Chicago Metal Hose Corp., Maywood, Ill.

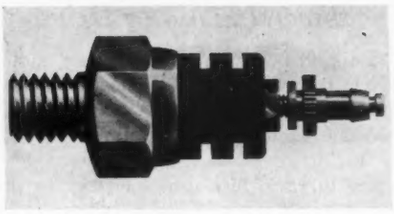
## *Multiple Disk Type Clutch*

Designed for machine tool and other installations where space is limited. Known as Model MT, this new clutch is of a simplified design, is said to cost less, and because of its different action, has an easier, smoother engagement and release with less engaging pressure. Available in nine sizes, in single or duplex units, to run dry or in oil. Minute adjustments on all sizes can be made from a single point to give maximum capacity from minimum lever pressure Twin Disc Clutch Co., Racine, Wis.



## *Synthetic Textile Fiber*

Christened "nylon," this material can be fashioned into filaments as strong as steel, as fine as the spider's web, yet more elastic than any of the common natural fibers and possessing a beautiful luster. Its chemical and physical properties differ radically from all other synthetic fibers and is claimed to be the first man-made organic textile fiber prepared from raw materials of the mineral kingdom. It is made of coal, water and air. Possible uses include brush bristles, racquet strings, transparent wrapping film, plastics, and coated fabrics. Among other prospective uses for nylon is a high twist yarn for hosiery which is claimed to possess extreme sheerness, high elasticity, high strength, and improved resistance to runs. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

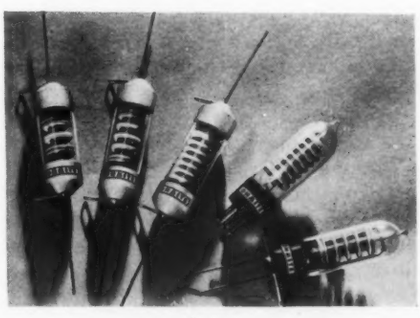


## *Thermo-Safety Device*

Designed for closing an electrical circuit upon rise of temperature to a predetermined degree. It contains two electrical contacts normally held apart a sufficient distance to prevent sparking across the electrical circuit in which it is used. The terminal is insulated from the body and has a binding screw to which one wire of the circuit is attached. The other end of the circuit must be grounded to the machine which is to be protected. When the protected machine part rises in temperature to a pre-determined degree the contacts are forced together, shorting the circuit between the terminal and the body. Any number of thermo-safety devices can be connected in series to one alarm or one spark plug or magneto. The device is vapor and moisture-proof and is made in standard temperature ratings for each type of application. Special ratings and designs can be furnished for special applications. Bart Products Co., Dewey Road, Bartlesville, Okla.

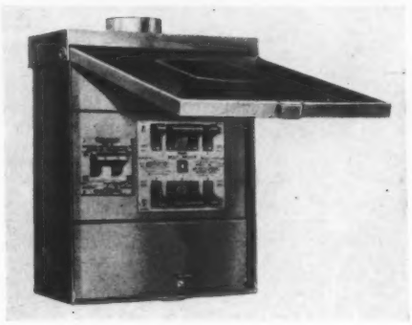
## *Precision Resistors*

Hermetically sealed glass inclosed precision resistors, designed to provide the ultimate in protection against humidity and atmospheric conditions. They consist of pie-wound resistors inclosed in evacuated glass tubes with the terminals emerging through vacuum-tight glass seals. Units are wound on 2, 4, 6, or 8 section procelain spools, non-inductive winding resistance 0.1 ohm to 2.5 megohms, 1 watt rating, 1 per cent accuracy (or better when required). Overall dimensions for 6 section unit: approximately 11/16 in. O.D. x 2⅜ in. long. Strong glass tube-insulating end caps, with soldering lugs and wire terminals, or tube base. Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago, Ill.



## *Multi-Breaker Combination*

Known as Type MBM, designed to facilitate wiring and to save space when it is necessary to meter a range or water heater separately from the other circuits. Besides providing for the lighting and device circuits (on one meter) the inclosure also provides space for a Type M double pole multi-breaker unit which is not connected to the other circuits and thus may be wired directly to another meter without changing the wiring within the box. Circuit capacities are 15, 20, 25, 35 and 50 amp., 115 and 115 to 230 volts a.c. Square D Co., Detroit, Mich.

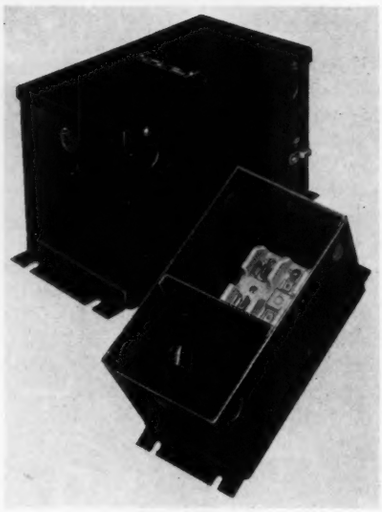


## *Permanent Ink*

A non-corrosive, non-inflammable permanent ink for writing on glass or enameled wear, known as Brand LN, which can be applied with any steel pen, drawing pen or fine brush. Permanency is increased by warming the writing. Tests have indicated that the ink will resist the action of such severe corrosive agents as hot sulfuric acid, hot nitric acid, hot hydrochloric acid and concentrated alkalies; and is not affected by the action of laboratory solvents. Stewart Research Laboratory, 315-22nd St., N. W., Washington, D. C.

## *Electrode for Cast Iron*

A heavily coated shielded-arc electrode designed for depositing a soft machinable alloy on cast iron. The coating on this wire, a non-ferrous alloy, is designed so as to cause the weld to flow over and bond to the cast iron with a minimum of penetration or heating of the base metal. While a single layer deposit will be machinable in the weld metal, at least two layers, each bead peened after depositing, should be deposited in order to obtain a soft fusion zone. The entire weld area may then be machined, sawed, drilled and tapped without difficulty. "Softweld" operates best with d.c. negative polarity, although a.c. may be used. Available in size 5/32 x 16 in. only. The Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio.



## *Transformer for Unit Lighting*

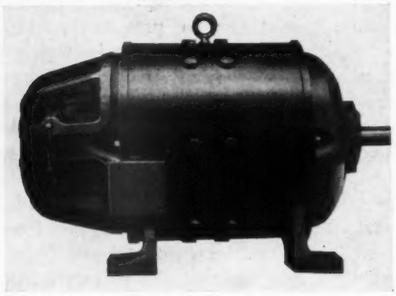
Designed to permit efficient, individual lighting of electrically-operated machines at low cost from high voltage power circuits. Known as the AmerTran Type UL, these units permit elimination of separate lighting circuits, drop lights and excessive general illumination. Designed to be mounted on a machine as an integral part and to have its input terminals connected to the high-voltage power circuit at the motor disconnecting switch. Low voltage for lamps is then available at the output receptacle of the transformer. Types are available for use where the power-circuit voltage is 115, 230, 460 or 575 volts and to supply any standard lamp voltage, such as 6, 32, 64 or 115 volts. Standard sizes are rated 75, 150, 225 and 300 watts output and are manufactured with the fuse block connected either in the high or low-voltage line. Bulletin 23-1 available. American Transformer Co., 178 Emmet St., Newark, N. J.

## *Graduated Beam Compass*

Feature of this compass is that radius setting is read directly on a telescoping slide and both a pen and a pencil are fixed permanently on the beam, thereby eliminating the necessity for changing from one to the other. There are no hinge points to cause errors. Construction is metal throughout. Available in sizes for drawing circles up to 36 in. diam. Favor Ruhl Co., 43 W. 23rd St., New York, N. Y.

## *Reversing Motor Drive*

Improved design of reversing motor drive for planers which makes use of armature speeds of 150–600 r.p.m. and 100–600 r.p.m. Full horsepower capacity is maintained over the entire range. Since there is less stored energy in the armature at the reduced speeds it stops quicker and gets under way quicker at the end of each stroke. Improvements in the control equipment include a pendent control station with extra buttons to provide added convenience for setting-up



operations. The master reversing switch mounted on the planer bed is direct-acting to speed up operation. The rheostat panel for controlling of cutting and return speeds is a separate unit for ease in mounting. Bulletin 306 containing complete data available. The Reliance Electric & Engineering Co., 1042–1090 Ivanhoe Road, Cleveland, Ohio.

## *Mercury Lamp*

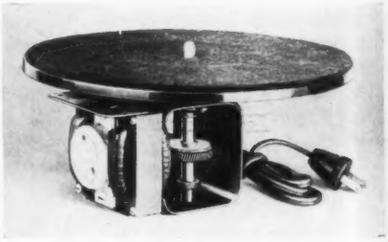
A new design of mercury vapor lamp which gives exceedingly intense and concentrated light such as required in searchlights, projectors and for therapeutic uses. Consists of a quartz tube about ¼ in. diam. with a capillary bore and cap at each end to confine a globule of mercury. Quartz tube is jacketed by glass for water cooling. Amount of light delivered ranges up to 65,000 lumens, about twelve times as brilliant as a filament projection lamp. The rays are highly actinic. Operation may be on either a.c. or d.c. Voltage drop is about 840 at 1¼ amp. and a ballast resistance is required when used on d.c., or a ballast impedence or a ballast transformer when using a.c. Westinghouse Lamp Div., Westinghouse Electric & Mfg. Co., Bloomfield, N. J.

## *Air Control Valves*

Two new solenoid controlled air valves especially designed for high-speed service such as required for numerous welding operations. One of the units is for the control of single acting and the other for the control of double acting cylinders. The poppet principle employed in their standard line is retained in both the single and double acting models. They are made in ⅜ in. pipe size, available in all standard current characteristics. Said to be especially adapted to production operations where extreme serviceability together with rapid interchanging of parts is of major importance. Valve proper or solenoid is removable by simply loosening four bolts. Ross Operating Valve Co., 6493 Epworth Blvd., Detroit, Mich.

## *Turn-Table*

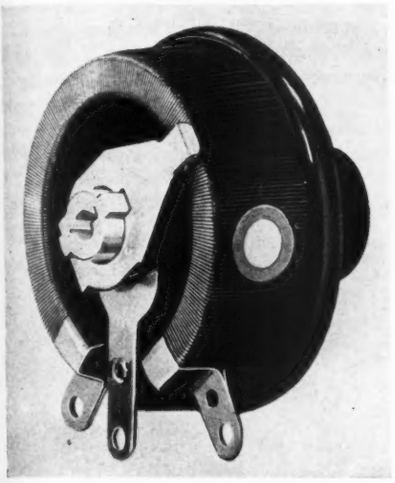
Driven by the new "Even Speed" motor which eliminates the need of a governor, yet maintains uniform speed through all variations of record drag. This motor maintains proper record speed regardless of variations in line voltage or operating temperature. Motor dimensions are 4-7/16 in. long, 3-1/4 in. wide, 2-3/16 in. deep to bottom of motor board, 4-11/32 in. from bottom of motor to top of spindle. Turn-table and motor (110



volt, 60 cycles) furnished complete with 5 ft. cord and rubber spools for mounting. Available with 9, 10 and 12 in. turntables. Alliance Mfg. Co., Alliance, Ohio.

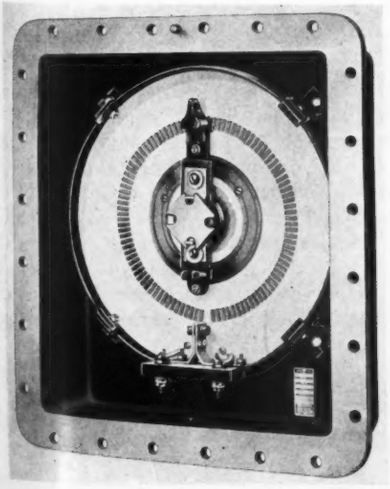
## *Low Power Rheostat*

An addition to their line of low power rheostats, a 75-watt power rheostat potentiometer, known as Model G., incorporating the features of the other Ohmite models. The physical dimensions and ratings of the new Model G falls between the Model J, 50 watt, and the Model K, 100-watt rheostat. It has a diameter of 2¾ in. and a mounting depth of 1¾ in. It is regularly supplied to mount on panels up to ¼ in. thick. Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill.



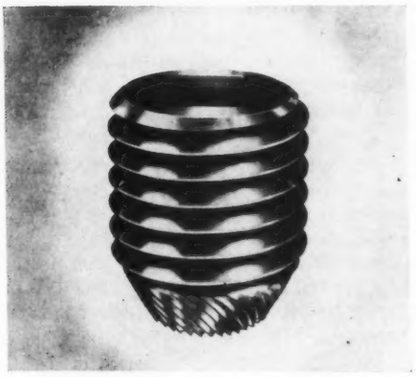
## *Explosion-Proof Inclosures*

Designed for Vitrohm pressed steel rheostats, these inclosures meet the requirements of Class 1, Group D hazardous locations. They are of the "Air Break type" for installation where explosive gases are present such as from gasoline and alcohol. All inclosures are of cast iron. A pad tapped for ½ in. pipe for the entrance of wires is provided on the bottom of the case. They accommodate 8, 13 and 15½ in. diam. Bulletin 60 Vitrohm pressed steel rheostats and are regularly furnished for front of board mounting but can be arranged for use with manual drive accessories. Complete data available in Bulletin 7001. Ward Leonard Electric Co., Mount Vernon, N. Y.



## *Rust Protection*

Known as "No-Rust Liquid V-15," recommended for protecting polished steel parts of machinery and tools against rust in storage and during shipment. May be applied with a brush or spray gun and requires no mixing or special preparation. It dries in 30 min., forming a tough, elastic, non-porous film which resists abrasion, moisture and salt air. The protective coating is readily removed by wiping with gasoline or kerosene. Frost Paint & Oil Corp., 1209 Northeast Tyler, Minneapolis, Minn.

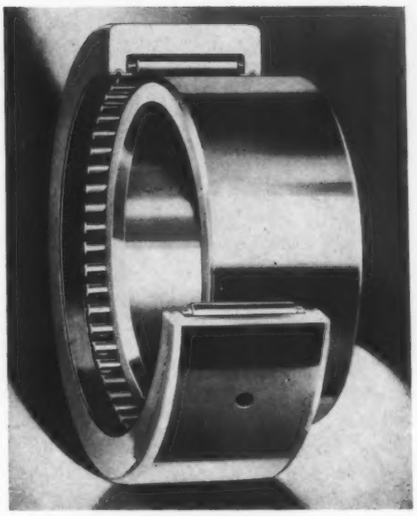


## *Knurled Point Setscrew*

Available with knurling all around the point. When turned into place the knurled edges effectively grip the shaft in such a manner that loosening or backing-off is claimed to be impossible except by the application of a wrench. Screws may be re-used in the same holes indefinitely. A wide range of sizes available. Standard Pressed Steel Co., Box 545, Jenkintown, Pa.

## *Short-Bake Enamel*

A porcelain-like, short-bake synthetic enamel, known as "Vitra-Carlite," which covers well in one coat, laying on with a full smooth film. It has good hardness and mar-proof qualities and has high chemical resistance, especially to oils and greases. It may be applied by brush, spray, dip or tumbling. Hilo Varnish Corp., 42-60 Stewart Ave., Brooklyn, N. Y.

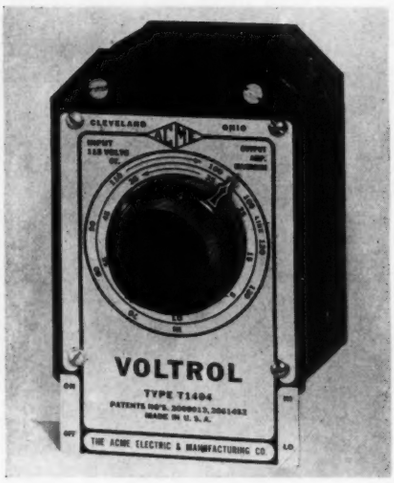


## *Needle Roller Bearing*

A heavy-duty needle roller bearing, known as the "Standard Quill Bearing," having a one-piece, rigid, channel-shaped outer race in which a full complement of small diameter rollers is firmly held. A spring steel-band is employed to maintain the rollers and outer race as a unit during assembly but is not called upon to carry any load while operating. The rigid rib surfaces of the outer race are accurately hardened and ground, keeping rollers in perfect alignment. Bearings are available either with or without inner races in a complete range of sizes for shafts from ¾ to 5 in. Bulletin 103R describing these bearings is available. Bantam Bearing Corp., South Bend, Ind.

## *"Pregwood"*

A strong, light-weight material, especially suitable for various mechanical and electrical uses. Consists of thin laminations of wood impregnated with phenolic resins and vulcanized into a hard homogeneous sheet. It is said to be lighter than aluminum, specific gravity 1.35, and has a flexural strength of 25,000 to 30,000 lb. per sq. in. Tested parallel to the laminations it will stand 60 v.p.m. It is highly resistant to moisture absorption and shows a minimum of dimensional change due to moisture and humidity. It also has a low co-efficient of thermal expansion. Material is made in sheets ¼ in. or thicker, 20 in. wide, and 96 in. long. Can also be furnished in the form of rods cut from sheets, but it is not available in tubing. The sheets may be built up with the grain of the wood plies running all in one direction, in which case it has exceptional strength in one direction only, or the plies may be arranged with the grain at a 90 deg. angle, in which case it has strength in both directions. The Formica Insulation Co., Cincinnati, Ohio.

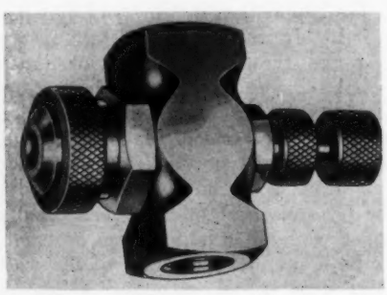



## *Voltage Regulator*

A panel type Voltrol designed as an integral part for electrical testing apparatus, which permits stepless adjustment of a.c. voltage from 0 to 135 volts. Basically this unit consists of a specially designed heavy-duty auto transformer. It has non-burning, non-fusing, self-lubricating rheostat contacts that tap each individual turn of the winding, and thus makes possible a more accurate control of the output voltage. Tests have shown the accuracy of the instrument to adjustments within 4/10 of a volt. Acme Electric & Mfg. Co., Cuba, N. Y.

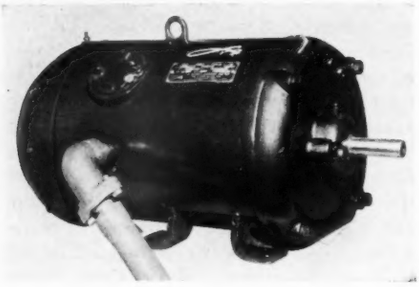
## *Pneumatic Automizing Nozzle*

Available with externally mixed round spray, internally mixed round spray, and internally mixed flat spray. Compressed air and liquid pipe connections are both ¼ in. female. Standard stock construction is brass; other metals can be specified. Nozzle is for humidifying, industrial and chemical processes, paper and textile web spraying. Spraying System Co., 4922 W. Grand Ave., Chicago, Ill.



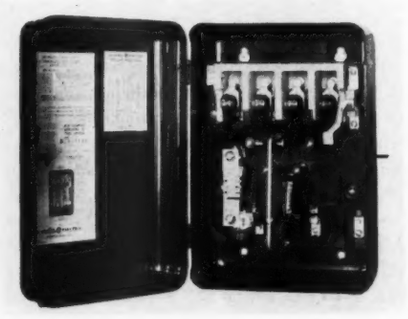
## *Explosion-Proof Motors*

Small compact overall dimensions make these motors interchangeable with a.c. and d.c. NEMA frame sizes with reference to NEMA dimensions D and shaft sizes. Their unusually low overall height makes them particularly adaptable for use in low overhead mines. Construction features include heavy cast-aluminum air intake grill, radial type aluminum alloy cast fan, reinforced end brackets, alemite lubrication with overflow drain plug, extra heavy solid steel field ring, ball bearings, dynamically balanced armature. Available in a wide range of both electrical and mechanical modifications. Descriptive Bulletin 520 available. The Louis Allis Co., Milwaukee, Wis.



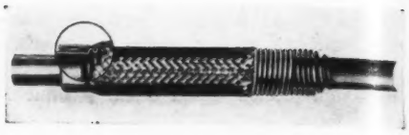
## *Magnetic Switch*

Designed for use with single-phase motors, this new starter consists of a standard general-purpose, 4-pole magnetic switch with two poles connected in parallel. This arrangement makes the device equivalent to a 2-pole switch with one overload relay. Its application is limited to use with single-phase motors whose normal full-load current does not exceed 30 amp. Available in ratings of 3 hp. at 110 volts, 5 hp. at 220 volts, and 7½ hp. at 440 volts. General Electric Co., Schenectady, N. Y.



## *Vibration Absorber*

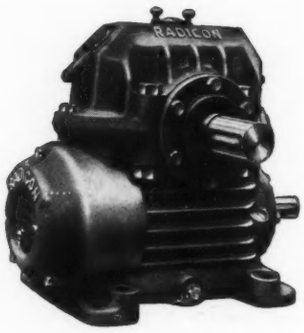
Manufactured from seamless bronze tubing drawn into a helical flexible tube, by a process which permits the use of tubing of extra wall thickness and strength without sacrificing flexibility. Plain straight end extensions are provided to slip over standard piping or to make up to standard fittings. A special feature is the one-piece construction of the absorber tube, which is of uniform



temper with no soft spots. No welding is employed. A positive seal is perfected by the permanent double-clamping of the high-tensile bronze braid casing by means of (a) a metal ring snugly encircling the tube and gripping the braid end, and (b) the soldered ferrule which envelops ring and braid end completely and tightly. Available in a wide range of sizes from ¼ in. tube I.D. to 6 in. I.D. Packless Metal Products Corp., Long Island City, N. Y.

## *Radicon Worm Reducer*

The principal feature of this worm reducer is a fan mounted on the high-speed shaft for the purpose of projecting a stream of cold air at high velocity along horizontal channels on the gear housing. It is claimed that the patented shaped gear teeth, in conjunction with the special cooling methods, makes possible as much as 100 per cent in-




crease in load carrying capacity, or for a given rating a 30 per cent reduction in size. Manufactured by David Brown & Sons of Huddersfield, England. Exclusive distributors in the U. S., Thomas Prosser & Son, 120 Wall St., New York, N. Y.

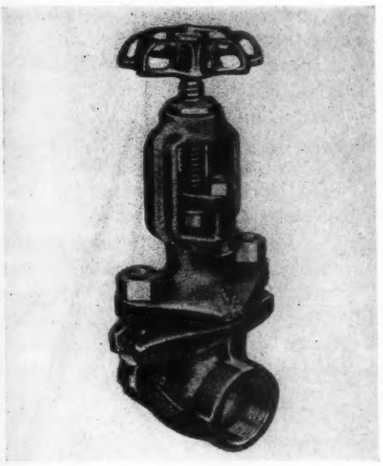
## *Pocket Drafter*

Known as the "U-Draft" pocket drafter, combining T-square, triangles and drafting scales into a unique combination. The instrument consists of a graduated scale and a protractor head on which lines are inscribed at 15 deg. angles to the horizontal scale. It is 7½ in. long overall and 1½ in. wide and is made of pyroxylin specially treated drawing instrument material. All of the scales are engine

divided on the pyroxylin. A metal stiffener eyelet to the pyroxylin keeps the instrument flat. It is supplied in four different graduations, full size 1/16 in., millimeters, full size 1/10 in., and also ⅛ in. and ¼ in. equals one foot. List price is 50 cents. L. G. Wright, Inc., 5209-78 Euclid Ave., Cleveland, Ohio.

### *Magnet Wire*

Glass-insulated magnet wire, known as "Deltaglass" magnet wire, recommended for apparatus windings where the temperature does not exceed 125 deg. C. It is wound with a glass yarn to which Glyptal varnish is applied, after which another layer of glass yarn is wound on. The Glyptal varnish permeates both layers, binding them together and to the copper conductor. The varnish also seals the glass and furnishes a smooth, uniform, moisture-resistant surface. Wire is available in round, square and rectangular shapes. General Electric Co., Bridgeport, Conn.

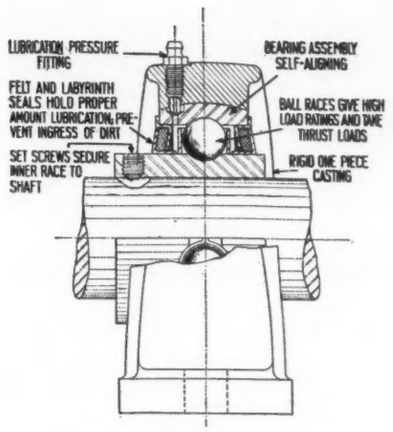


### *Stainless Steel Valves*

A line of corrosion-resisting stainless steel valves, made of 18-8 S, and 18-8 SMO, each having a carbon content limited to a maximum of 0.10 per cent. Both are highly resistant to corrosion, but 18-8 SMO is used under most severe conditions. Available in seven different styles, either screwed or flanged, in sizes from ½ to 3 in. Jenkins Bros., 80 White St., New York, N. Y.

### *Ball Bearing Pillow Blocks*

A line of permanently sealed, self-aligning ball bearing pillow blocks. The self-aligning bearing assembly is permanently sealed with felt and labyrinth seal that also incorporates the flinger seal pressed upon the inner race ring. Ball bearings are deep grooved to take


LUBRICATION PRESSURE FITTING
BEARING ASSEMBLY SELF-ALIGNING
FELT AND LABYRINTH SEALS HOLD PROPER AMOUNT LUBRICATION, PREVENT INGRESS OF DIRT
BALL RACES GIVE HIGH LOAD RATINGS AND TAKE THRUST LOADS
SET SCREWS SECURE INNER RACE TO SHAFT
RIGID ONE PIECE CASTING

both radial and thrust loads, the inner race being extended and held to rotate with the shaft by means of a setscrew. Alemite fittings provide lubrication. Available for shafts from 1$\frac{7}{16}$ to 2$\frac{11}{16}$ in. diam. Descriptive Catalog 7538 available. Stephens-Adamson Mfg. Co., Aurora, Ill.

### *Fillet Welding Electrode*

Murex Fillex, an addition to the Murex line of heavy coated electrodes for manual arc welding. Designed for fillet welding and other downhand work. Welds made with this electrode are said to have physical properties meeting the American Welding Society's specifications for Grade 10 filler metal. The outstanding feature claimed is low cost of deposited metal. Used at unusually high amperages, Fillex will not undercut. Descriptive literature available. Metal & Thermit Corp., 120 Broadway, New York, N. Y.

# Manufacturers' Publications

ALLOY CASTINGS—Michiana Products Corp., Michigan City, Ind. Booklet 108, 16 pages, 8½x11 in. Gives essential data and information on heat and corrosion-resistant alloy castings. Numerous illustrations showing the variety of work done by the company are included. A section is also devoted to centrifugal castings.

BALL BEARINGS—Nice Ball Bearing Co., Nicetown, Philadelphia, Pa. Catalog 106, 65 pages, 4¼x7½ in. Latest catalog listing of their line of ball bearings, ball retainers, thrust ball bearings, radial ball bearings, combination type ball bearings, and sheaves, wheels and casters.

BEARINGS—Federal-Mogul Corp., Detroit, Mich. Booklet, 16 pages, 5¾x8½ in. Illustrating and describing the various types of engine bearings, bearing liners, and bushings in general use, the newer types coming into wider use, and the methods of design and manufacture. A wide variety of modern bearing and bushing applications on machines and appliances are also shown.

CHAINS AND SPROCKETS—Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis. Catalog 333, 130 pages, 8¾x10¾ in. Covering their line of Rex roller chains and sprockets with list prices and dimensions. Also includes engineering information on selection and application of roller chain drives.

CASTINGS—The Chicago Hardware Foundry Co., North Chicago, Ill. Booklet, 10 pages, 8½x11 in. Covering their plant facilities and the great variety of castings produced, methods of annealing and normalizing castings and plating.

ELECTRICAL EQUIPMENT—General Radio Co., Cambridge, Mass. Catalog K, 216 pages, 6¾x10 in. Complete details and illustrations covering their products, including industrial devices, resistors, capacitors, oscillators, amplifiers, meters, instruments, power supplies, transformers, etc.

"FACTS ABOUT REPUBLIC STANDARD PIPE"—Republic Steel Corp., Cleveland, Ohio. Bulletin Adv. 316, 10 pages. Containing bundling tables, sizes and weights, identification and corrosion information on Republic standard pipe, copper-bearing steel pipe and Toncan copper molybdenum iron pipe.

FORGINGS—Drop Forging Association, 605 Hanna Bldg., Cleveland, Ohio. Sheet, 11x17 in. The latest revised list of all the known forging trade marks.

LEATHER PACKINGS—Alexander Bros., 406 N. Third St., Philadelphia, Pa. Catalog A-49, 32 pages, 3½x6¼ in. Setting forth the outstanding features of Alexander leather packings, together with descriptive data and illustrations.

LIGHTING—Westinghouse Electric & Mfg. Co., Cleveland, Ohio. Catalog Section 61-256, 8½x11 in. Type GB Luminaires, indirect lighting units with glass basins, designed specifically for use with incandescent medium Bipost lamps are described and illustrated.

MAGNETIC CLUTCHES—Stearns Magnetic Mfg. Co., Milwaukee, Wis. Folder No. 112. Describing their line of magnetic clutches, magnetic clutch-brake combinations and magnetic brakes.

MAGNETIC STARTERS—General Electric Co., Schenectady, N. Y. Bulletin GEA-2954, 4 pages, 8x10½ in. Data covering reduced-voltage autotransformer-type a.c. magnetic starters, Type CR7051.

MOTORS—The Dumore Co., Racine, Wis. Booklet, 16 pages, 9x12 in. A reprint of a series of advertisements used by Dumore during 1938.

MOTOR REDUCERS — Philadelphia Gear Works, Philadelphia, Pa. Catalog, 40 pages. Covering their complete line of vertical and horizontal type MotoReduceR, and shows them equipped with various types of motors which can be supplied as standard design.

MOLDING PRESSES—F. J. Stokes Machine Co., Tabor Road, Philadelphia, Pa. Folder, 6 pages, 8½x11 in. Descriptive details concerning their standard self-contained, toggle type molding presses, including a new 200-ton model.

NICKEL-CLAD STEEL—Lukens Steel Co., Coatesville, Pa. Bulletin T-4, 16 pages, 8½x11 in. A revised edition of their bulletin on methods for the fabrication of Lukens nickel-clad steel.

PHILLIPS SCREW DRIVERS—The Apex Machine & Tool Co., Dayton, Ohio. Folder on Apex screw drivers and power bits for Phillips screws and bolts.

RECESSED HEAD SCREWS—American Screw Co., Providence, R. I., Folder, 6 pages, 8½x11 in. Setting forth some of the outstanding features and advantages of American PLUS Screws with the patented Phillips recessed head.

RELAYS—The Autocall Co., Shelby, Ohio. Bulletin, 16 pages, 8½x11 in. Illustrations and detailed data covering their new complete line of relays and control equipment.

REMOTE MEASUREMENT AND CONTROL — The Foxboro Co., Foxboro, Mass. Bulletin 227, 7 pages, 8½x11 in. Describing their new pneumatic transmission system for remote measurement and control of flow, temperature, level and pressure.

ROLLER BEARINGS—Bower Roller Bearing Co., 3040 Hart Ave., Detroit, Mich. "Engineering Journal," 60 pages, loose-leaf, 9¾x 11¾ in. The introductory section of this book is devoted to details and photographic views of the plant, showing principal departments and specialized equipment devoted to roller bearing manufacture. Following this are sections covering technical data, drawings and essential information relating to the mechanical design, processing, application and functioning of Bower roller bearings.

SOLENOID VALVES—Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago, Ill. Bulletin S-1, 15 pages, 8½x11 in. Illustrating and describing their line of solenoid valves for general service on steam, air, gas and liquid, and covering their applications.

SPEED REDUCERS—The Ohio Gear Co., 1333 East 179th St., Cleveland, Ohio. "Six Steps to Lower Power Costs," 4 pages, 4x7½ in. List prices, ratings and dimensions of speed reducers.

VARIABLE-SPEED TRANSMISSION—The Lenney Machine & Mfg. Co., Warren, Ohio. Booklet, 16 pages, 8½x11 in. Types, capacities and dimensions, together with applications, of both separate and motorized units.

ZINC ALLOY DIE CASTINGS—The New Jersey Zinc Co., 160 Front St., New York, N. Y. Two booklets, 4x7½ in. "Zinc Alloy Die Castings in Industrial Equipment" and "Zinc Alloy Die Castings in Hardware," setting forth the growing use of die-castings in industrial equipment and hardware, respectively.

# Books and Bulletins

## *Mechanical Engineers' Handbook*

### *Vol. III — Design, Shop Practice*

ROBERT THURSTON KENT, *Editor-in-Chief. 1,378 pages, 5¾x8½ in. Semi-flexible covers. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $5.00.*

Compiled and written with the collaboration of a staff of specialists, this third volume in the Wiley Engineering Handbook Series contains material that is of much value to mechanical engineers whose activities are associated with the design of machines and shop practice, in short, this volume covers the practice of mechanical engineering with the exception of applied thermodynamics which subject is covered in Volume II—Power of the handbook series.

This edition has sections devoted to materials, strength of materials, mechanisms and mechanics, mechanical parts, structures and buildings; forging, foundry, machine shop and woodworking practice and equipment; materials handling, mechanical power transmission, electric motors and their control. The text is copiously supplemented with tabular material. Data throughout the book has been thoroughly revised to agree with present day practice.

## *Chemical Tables*

CHARLES D. HODGMAN, *Editor-in-Chief. 1,400 pages, 5¼x7½ in. Semi-flexible covers. Published by the Chemical Rubber Publishing Co., 1900 West 112th St., Cleveland, Ohio. Price $2.50.*

This book is a compilation of chemical tables from the handbook of chemistry and physics. In addition to the usual mathematical tables, the book includes tables of properties and physical constants such as atomic weights, the periodic table, physical constants of organic compounds, common minerals, and similar tables.

Another group of general chemical tables gives the qualitative analysis scheme, flame and bead tests, solubility charts, dissociation constants of bases, etc.

The tables of specific gravity and properties of matter cover the specific gravity of aqueous solutions, the density of elements, alloys and other solids, and the densities of common liquids and gases. Seven tables give the surface tensions of liquids in metals and there are four tables on viscosity.

In the division on heat the tables include thermal expansion, specific heat, boiling points, freezing mixtures, vapor pressures and numerous others. There are eight hygrometric and barometric tables, eleven tables on electricity and twenty-two tables on light.

Among the seven miscellaneous tables are photographic formulas, laboratory arts and recipes, and resistance tables.

## *Metal Coloring and Finishing*

HUGO KRAUSE. *220 pages, 6¼x9¼ in. Blue clothboard covers. Published by the Chemical Publishing Co., 148 Lafayette St., New York, N. Y. Price $5.00.*

This is an authorized translation from the second revised edition of the German book by the same name. The volume discusses from the theoretical, practical applications, and patent angles the subject of metal coloring by chemical, mechanical, and electrical methods as applied to sheet, cast or mechanically fabricated forms of metal.

The book is arranged primarily to be useful as a record guide to those engaged in metal coloring for decorative as well as protective purposes. Many of the so-called secret processes of the electroplating art are described in detail and considerable attention is given to American practices.

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### *A.S.T.M. Standards 1938 Supplement*

*245 pages, 6x9 in. Published by the* AMERICAN SOCIETY OF TESTING MATERIALS, *260 S. Broad St., Philadelphia, Pa.*

This pamphlet is the second supplement to the 1936 A.S.T.M. Standards and contains 57 standards adopted or revised by the society on September 1, 1938. Thirty-two of the standards are new and the remaining twenty-five are replacements of existing standards.

### *Fatigue Tests of Riveted Joints*

WILBUR M. WILSON AND FRANK P. THOMAS. *116 pages, 6x9 in. Bulletin 302, Engineering Experimental Station, University of Illinois, Urbana, Ill.*

A report of the investigations to determine the fatigue strength of riveted joints connecting structural steel plates. In the specimens tested all rivets were in double shear and all had a nominal diameter of 1 in. In most of the tests the stress range varied from zero to a maximum tension.

# *D. C. Magnet Coils*

## Method for Calculating Ampere Turns

GRAHAM LEE MOSES
*Westinghouse Electric & Manufacturing Company*

THE MAGNETIC PRESSURE produced by a d.c. magnet coil is evaluated in ampere-turns. Assuming a single turn coil around a core, the ampere-turns are the same numerical value as the amperes (amperes x 1 turn). By Ohm's law, the amperes are determined by the resistance of the copper in a single turn and the voltage applied. Where the voltage is fixed by other factors, therefore, the resistance of the single turn is the only factor determining the number of ampere-turns a single turn coil will produce.

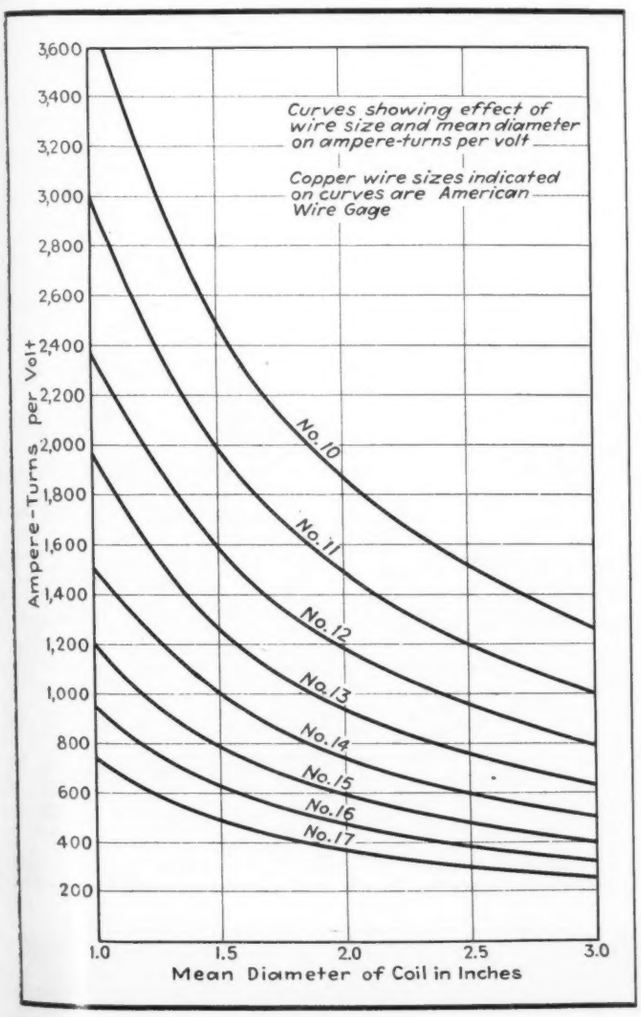
There are two factors which determine the resistance of a single-turn (copper) coil namely,

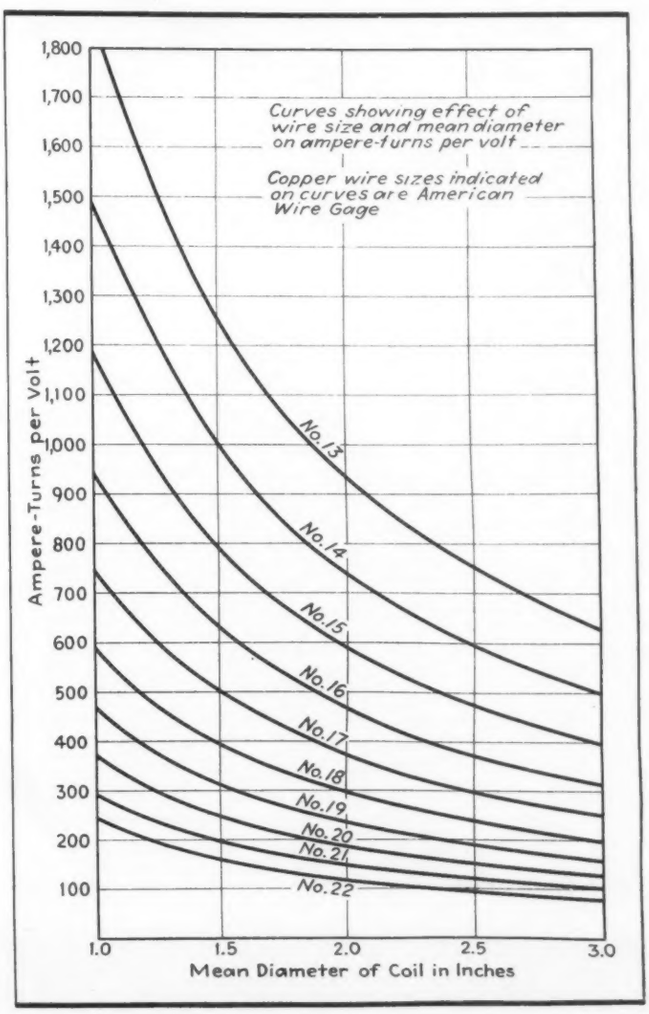
(1) The size of the conductor, as the resistance per unit length varies inversely as the cross section.

(2) The length of the turn, as the resistance increases directly with the length.

From this it is apparent that, for any given voltage the ampere-turns for a single turn are determined only by size of conductor and length of turn. Likewise the ampere-turns per volt for a given wire size are dependent solely on length of turn.

Next the effect of increasing the number of turns is considered. If the number of turns of the same average length and same size of wire are increased from 1 to 2 (or to 1,000) the



resistance is doubled (or increased 1,000 to 1). The amperes for a given voltage are therefore reduced in exactly the same proportion that turns are increased. The product of amperes and turns is therefore unchanged by increasing the number of turns.

From the above it is obvious that it is not necessary to determine the number of turns in a coil to estimate the ampere-turns produced with a certain wire size. It is only necessary to determine the ampere-turns produced at the specified voltage by a single turn of any particular wire size, calculating the turn resistance on the length of the average or mean turn.

These relations can be expressed as equations, thus:

Where $R$ = Total resistance of coil of $N$ turns
$Y$ = Resistance of mean turn
$E$ = Volts, d.c.
$I$ = Amperes
$N$ = Turns
$IN$ = Ampere-turns
$L$ = Length of mean turn in inches
$C$ = Cross section of conductor in circular mils

$$Y = \frac{10.55}{C} \times \frac{L}{12} = \frac{L}{C} \times 0.88 \quad \text{.....(1)}$$

$$IN = \frac{E}{R} \times N = \frac{E \times N}{Y \times N} = \frac{E}{Y} \quad \text{.....(2)}$$

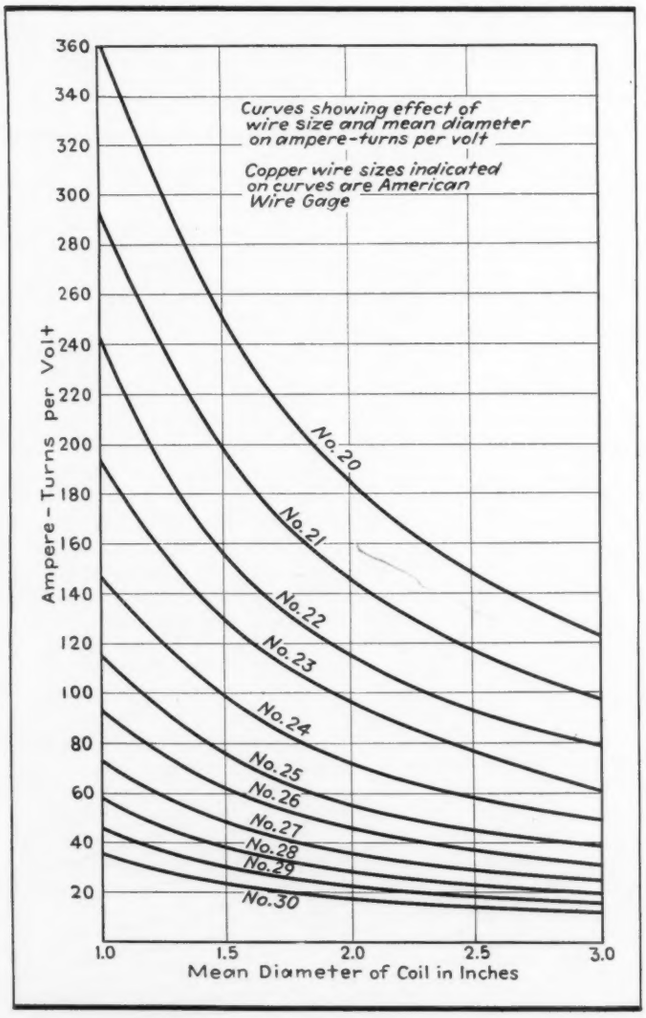
From Equation 2 another relation can be readily derived, which is

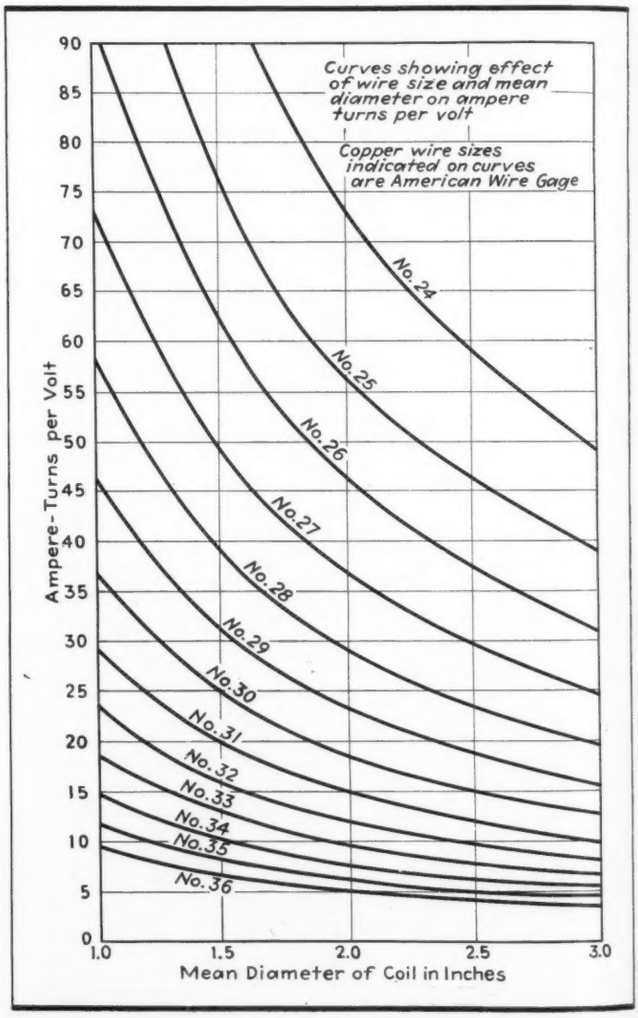
$$C = \frac{IN \times L \times 0.88}{E} \quad \text{.....(3)}$$

Equation 3 provides a quick and easy way to determine the proper wire size to produce a specified number of ampere-turns with a given length of mean turn and voltage.

In the accompanying curves the mean diameter is plotted against ampere-turns per volt for commonly used wire sizes. From this it is easy to immediately select the proper wire size without going through any long drawn-out process of "cut and try."

It must be recognized that all these calculations are based on copper coils at room temperature with no change in resistance because of heating. The number of turns does affect the total resistance, the total watts generated, and the ability of the coil to dissipate the heat generated in its winding.



# 1938

# CLASSIFIED DIRECTORY

*Sources of Supply for Materials, Electrical and Mechanical Parts and Finishes Specified by Designing Engineers. Also a Separate Directory of Sources of Engineering Department Equipment and Supplies*

**ABRASIVE METALS**
*Non-Ferrous*
*Aluminum, bronze and copper nickel alloys with grains of abrasive materials.*
American Abrasive Metals Co., Irvington, N. J.
Carborundum Co., Niagara Falls, N. Y. (materials).
Eastern Malleable Iron Co., Naugatuck, Conn.
Eastern Malleable Iron Co., Wilmington, Del.
Erie Malleable Iron Co., Erie, Pa.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.
Pettibone Mulliken Corp., 4710 W. Division, Chicago.
Universal-Cyclops Steel Corp., Bridgeville, Pa.

**AIR COMPRESSORS**
*Small for unit mounting on machines used for pressure or vacuum.*
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Curtis Pneumatic Machy. Co., 1905 Keenlen Ave., St. Louis, Mo.
Dumore Co., The, Racine, Wis.
Gardner-Denver Co., Quincy, Ill.
Kinney Mfg. Co., 3529 Washington, Boston, Mass.
Kraissl Co., Terhune & Williams Ave., Hackensack, N. J.
Leiman Bros., Inc., 146-181 Christie, Newark, N. J. (rotary)
Midland Steel Products Co., Cleveland, Ohio
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Sullivan Machinery Co., Claremont, N. H.
Worthington Pump & Machinery Corp., Harrison, N. J.

**ALLOYING ELEMENTS**
*These companies supply alloying materials to makers of steel. They are excellent sources of technical information concerning the properties and uses of alloyed metals and are therefore listed here.*
Chromium Corp. of America, 120 Broadway, New York
Climax Molybdenum Co., 500 Fifth Ave., New York
Electro-Metallurgical Co., 30 E. 42nd, New York
**International Nickel Co., Inc., 67 Wall, New York**
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Vanadium Corporation of America, Bridgeville, Pa.

**ALUMINUM, FORGINGS**
*(See also Forgings, Drop)*
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nicralumin Co., 146 W. Cortland, Jackson, Mich.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**

**AMMETERS**
*For mounting on machines*
Clough-Brengle Co., 2815 W. 19th, Chicago
Engelhard, Charles, Inc., 90 Chestnut, Newark, N. J.
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York
**General Electric Co., Schenectady, N. Y.**
Norton Electrical Instrument Co., Manchester, Conn.
Rawson Elec. Instrument Co., 110 Potter, Cambridge, Mass.
Reliance Instrument Co., 1135 W. Van Buren, Chicago
Rochester Mfg., Co., Rochester, N. Y.
Roller-Smith Co., 233 Broadway, New York
Sensitive Research Inst. Corp., 4545 Bronx Blvd., New York
Triplett Electrical Instrument Co., Bluffton, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Corp., 614 Frelinghuysen Ave., Newark, N. J.

**ANODIC FINISH**
**(Alumiliting)**
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
Electric Products Co., 1725 Clarkstone Rd., Cleveland, O.
Grammes, L. F. & Sons, Inc., Allentown, Pa.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio.
Weatherhead Co., The, 300 E. 131st, Cleveland, Ohio

**BABBITT METAL**
Alpha Metal and Rolling Mills, Inc., 363 Hudson, Brooklyn, N. Y.
American Crucible Products Co., Lorain, Ohio
Belmont Smelting & Refining Works, Inc., 807 Belmont Ave., Brooklyn, N. Y.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit.
**Bunting Brass & Bronze Co., Toledo, Ohio**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Dodge Mfg. Corp., Mishawaka, Ind.
Empire Metal Co., Syracuse, N. Y.
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
National Lead Co., 111 Broadway, New York

***For further information on companies listed in bold face type, see index on last page***

ONLY Ampco Metal, Inc. understands the method of combining copper, aluminum and iron to produce the "Ampco Phase" . . . the particular structural formation which provides Ampco Metal with those unmatched qualities which have led to its adoption by hundreds of nationally prominent manufacturers.

If you require a non-ferrous alloy that provides the utmost in wear resistance — tensile strength — corrosion resistance then insist on genuine Ampco Metal, distinguished by the diamond trade mark reproduced here. It is available only from this Company and its four licensee foundries . . . in six grades of varying hardness and physical properties. The book "Ampco Metal — Its Uses in Modern Industry" will interest you.

**AMPCO METAL, INC.**

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**BABBITT METAL (Cont.)**

Penney, J. W. & Sons Co., 16 Maple, Mechanic Falls, Me.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
United Metals, 620 Hamilton, Spokane, Wash.

**BALLS, STEEL AND BRONZE**

*Ground and Polished*

Abbott Ball Co., Hartford, Conn.
Hartford Steel Ball Co., 12 Jefferson Ave., Hartford, Conn.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
**New Departure, Div. General Motors, Bristol, Conn.**
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.

**BARS, ALUMINUM**

**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
Nicralumin Co., 146 W. Cortland, Jackson, Mich.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.

**BARS, ALUMINUM BRONZE**

**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bridgeport Brass Co., Bridgeport, Conn.**
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York
Shenango-Penn Mold Co., Dover, Ohio

**BARS, BRASS AND BRONZE**

*Cast for Bushings and Bearings*

Allan, A., & Son, 6th & Bergen Sts., Harrison, N. J.
Allen, W. D., Mfg. Co., 566 W. Lake, Chicago
Aluminum Industries, Inc., 2416 Beekman, Cincinnati, Ohio
American Crucible Products Co., Lorain, Ohio
**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Belmont Smelting & Refining Works, Inc., 807 Belmont Ave., Brooklyn, N. Y.
Bissett Steel Co., Cleveland, O.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Buckeye Iron & Brass Works, 324 E. 3rd, Dayton, Ohio
**Bunting Brass & Bronze Co., Toledo, Ohio**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Detroit Aluminum & Brass Corp., Detroit, Mich.
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
Green Bay Foundry & Machine Works, Green Bay, Wis.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Klotz Machine Co., Sandusky, Ohio
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Riverside Metal Co., Riverside, N. J. (bronze)
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Shenango-Penn Mold Co., Dover, Ohio
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y. (bronze)
Turner & Seymour Mfg. Co., Torrington, Conn.

**BARS, BRASS AND BRONZE**

*Rolled and Extruded Shapes*

**American Brass Co., Waterbury, Conn.**
Bissett Steel Co., Cleveland, Ohio
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bridgeport Brass Co., Bridgeport, Conn.**
Chase Brass & Copper Co., Waterbury, Conn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Plume & Atwood Mfg. Co., 470 Bank, Waterbury, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Riverside Metal Co., Riverside, N. J. (rolled)
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Titan Metal Mfg. Co., Bellefonte, Pa.
Western Cartridge Co., East Alton, Ill.

**BARS, MANGANESE BRONZE**

**American Brass Co., Waterbury, Conn.**

***For further information on companies listed***

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bridgeport Brass Co., Bridgeport, Conn.**
Chase Brass & Copper Co., Waterbury, Conn.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Shenango-Penn Mold Co., Dover, Ohio

**BARS, PHOSPHOR BRONZE, CAST**
**American Brass Co., Waterbury, Conn.**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bridgeport Brass Co., Bridgeport, Conn.**
**Bunting Brass & Bronze Co., Toledo, Ohio**
Chase Brass & Copper Co., Waterbury, Conn.
Detroit Aluminum & Brass Corp., Detroit, Mch.
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Riverside Metal Co., Riverside, N. J.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Seymour Mfg. Co., Seymour, Conn.
Shenango-Penn Mold Co., Dover, Ohio

**BARS, SILICON BRONZE**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bridgeport Brass Co., Bridgeport, Conn.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Frontier Products Corp., Mineral Ridge, Ohio
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York
Shenango-Penn Mold Co., Dover, Ohio

**BARS, COPPER-NICKEL**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
Driver-Harris Co., Harrison, N. J.
Frontier Products Corp., Mineral Ridge, Ohio
Hoskins Mfg. Co., 4445 Lawton Ave., Detroit, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York
Riverside Metal Co., Riverside, N. J.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Seymour Mfg. Co., Seymour, Conn.
Shenango-Penn Mold Co., Dover, Ohio

**BARS, COPPER-SILICON**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
Revere Copper & Brass Inc., 230 Park Ave., New York
Shenango-Penn Mold Co., Dover, Ohio

**BARS, MAGNESIUM ALLOY**
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
American Magnesium Corp., 2210 Harvard Ave., Cleveland, Ohio
**Dow Chemical Co., Midland, Mich.**

**BARS, NICKEL-SILVER**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
Driver-Harris Co., Harrison, N. J.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York
Riverside Metal Co., Riverside, N. J.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Seymour Mfg. Co., Seymour, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Western Cartridge Co., East Alton, Ill.

**BARS, STEEL, ALLOY**
*Cold-Drawn Rounds and Flats*
Allegheny Steel Co., Brackenridge, Pa.
American Rolling Mill Co., Middletown, Ohio
**American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio**
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
Bliss & Laughlin, Harvey, Ill.
**Carpenter Steel Co., Reading, Pa.**
**Columbia Steel Co., U. S. Steel Corp. Subsidiary, San Francisco, Calif.**
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Cumberland Steel Co., Cumberland, Md.
Halcomb Steel Co., Syracuse, N. Y.
LaSalle Steel Co., Box 6800-A, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Mitchell Steel Co., Stock Yards Sta., Cincinnati, Ohio
Moltrup Steel Products Co., Beaver Falls, Pa.
Monarch Steel Co., 543 W. McCarty, Indianapolis, Ind.
Republic Steel Corp., Cleveland, Ohio
**Rustless Iron & Steel Corp., Baltimore, Md.**
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Timken Roller Bearing Co., Canton, Ohio
Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio
**United States Steel Corp., 71 Broadway, New York**
Vanadium-Alloys Steel Co., Latrobe, Pa.

**BARS, STEEL, ALLOY**
*Cold-Drawn Special Sections*
Allegheny Steel Co., Brackenridge, Pa.
**American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio**
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
Bliss & Laughlin, Harvey, Ill.
**Columbia Steel Co., U. S. Steel Corp. Subsidiary, San Francisco, Calif.**
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Halcomb Steel Co., Syracuse, N. Y.
LaSalle Steel Co., Box 6800-A, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Republic Steel Corp., Cleveland, Ohio
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th, Chicago
Union Drawn Steel Div., Republic Steel, Massillon, Ohio
**United States Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville, Pa.

**BARS, STEEL ALLOY**
*Ground and Polished*
Allegheny Steel Co., Brackenridge, Pa.
**American Steel & Wire Co., Cleveland, Ohio**
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
Bliss & Laughlin, Harvey, Ill.
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
**Carpenter Steel Co., Reading, Pa.**
**Columbia Steel Co., U. S. Steel Corp., Subsidiary, San Francisco, Calif.**
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Halcomb Steel Co., Syracuse, N. Y.
Heppenstall Co., 4625 Hatfield, Pittsburgh, Pa.
LaSalle Steel Co., Box 6800-A, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Midvale Co., Philadelphia, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Monarch Steel Co., 543 W. McCarty, Indianapolis, Ind.
Republic Steel Corp., Cleveland, Ohio
**Rustless Iron & Steel Corp., Baltimore, Md.**
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Timken Roller Bearing Co., Canton, Ohio
Union Drawn Steel Div., Republic Steel, Massillon, Ohio
**United States Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville. Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

**BARS, STEEL ALLOY**
*Hot Rolled*
Allegheny Steel Co., Brackenridge, Pa.
American Rolling Mill Co., Middletown, Ohio
Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
**Carpenter Steel Co., Reading, Pa.**
**Columbia Steel Co., U. S. Steel Corp. Subsidiary, San Francisco, Calif.**
Crucible Steel Co. of America, 405 Lexington Ave., New York
Disston, Henry, & Sons, Inc., Philadelphia, Pa.
Halcomb Steel Co., Syracuse, N. Y.
Inland Steel Co., 38 S. Dearborn, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.
Midvale Co., Philadelphia, Pa.
Mitchell Steel Co., Stock Yards Sta., Cincinnati, Ohio
Republic Steel Corp., Cleveland, Ohio
**Rustless Iron & Steel Corp., Baltimore, Md.**
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago

*in bold face type, see index on last page*

**BARS, STEEL ALLOY**
*Hot Rolled (Cont.)*
Simonds Saw & Steel Co., Lockport, N. Y.
Timken Roller Bearing Co., Canton, Ohio
**United States Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

**BARS, STEEL, PLAIN CARBON**
*Cold-Drawn Rounds and Flats*
American Rolling Mill Co., Middletown, Ohio
**American Steel & Wire Co., Cleveland, Ohio**
Bissett Steel Co., Cleveland, Ohio
Bliss & Laughlin, Harvey, Ill.
**Columbia Steel Co., U. S. Steel Corp., Subsidiary, San Francisco, Calif.**
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Cumberland Steel Co., Cumberland, Md.
Halcomb Steel Co., Syracuse, N. Y.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
LaSalle Steel Co., Box 6800-A, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Mitchell Steel Co., Stock Yards Sta., Cincinnati, Ohio
Moltrup Steel Products Co., Beaver Falls, Pa.
Monarch Steel Co., 543 W. McCarty, Indianapolis, Ind.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Timken Roller Bearing Co., Canton, Ohio
Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio
**United States Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

**BARS, STEEL PLAIN CARBON**
*Cold-Drawn Special Sections*
**American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio**
Bissett Steel Co., Cleveland, Ohio
Bliss & Laughlin, Harvey, Ill.
**Columbia Steel Co., U. S. Steel Corp. subsidiary, San Francisco, Calif.**
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Halcomb Steel Co., Syracuse, N. Y.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
LaSalle Steel Co., Box 6800-A, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Monarch Steel Co., 543 W. McCarty, Indianapolis, Ind.
Republic Steel Corp., Cleveland, Ohio
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Timken Roller Bearing Co., Canton, Ohio
Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio
**United States Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

**BARS, WROUGHT IRON**
**Highland Iron & Steel Div., American Chain and Cable Co., Inc., Terre Haute, Ind.**
Bissett Steel Co., Cleveland, Ohio
Byers Co., A. M., Clark Bldg., Pittsburgh
Camden Forge Co., Camden, N. J.
Ulster Iron Works, 21 N. Sussex, Dover, N. J.

**BEARINGS**
*Copper-Lead Faced, Steel-Backed*
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit
**Bunting Brass & Bronze Co., Toledo, Ohio**
Federal Mogul Corp., Detroit
Moraine Products Div., General Motors Corp., Dayton, Ohio

**BEARINGS, BALL, ANGULAR**
Aetna Ball Bearing Co., 4600 Schubert Ave., Chicago
Ahlberg Bearing Co., 3024 W. 47th, Chicago
Bantam Ball Bearing Co., South Bend, Ind.
Bearings Company of America, Lancaster, Pa.
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Joy Ball Bearing Corp., 4550 W. Fulton, Chicago
Kilian Mfg. Co., 107 N. Franklin, Syracuse, N. Y.
**Marlin-Rockwell Corp., Jamestown, N. Y.**
**McGill Mfg. Co., Valparaiso, Ind.**
Messinger Bearing Co., Philadelphia, Pa.
**New Departure, Div. General Motors, Bristol, Conn.**
Nice Ball Bearing Co., Philadelphia, Pa.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Saginaw Stamping & Tool Co., 68 Williamson, Saginaw, Mich.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
**Torrington Co., Torrington, Conn.**
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, BALL, RADIAL**
Ahlberg Bearing Co., 3025 W. 47th, Chicago
Auburn Ball Bearing Co., Rochester, N. Y.
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
Bearings Company of America, Lancaster, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Joy Ball Bearing Corp., 4550 W. Fulton, Chicago
Kilian Mfg. Corp., 107 N. Franklin, Syracuse, N. Y.
Landis & Gyr, Inc., 104 Fifth Ave., New York (miniature sizes)
**Marlin-Rockwell Corp., Jamestown, N. Y.**
**McGill Mfg. Co., Valparaiso, Ind.**
Messinger Bearing Co., Philadelphia, Pa.
**New Departure, Div. General Motors, Bristol, Conn.**
Nice Ball Bearing Co., Philadelphia, Pa.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Saginaw Stamping & Tool Co., 68 Williamson, Saginaw, Mich.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)
**Torrington Co., Torrington, Conn.**
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, BALL, RADIAL AND AXIAL COMBINED**
Aetna Ball Bearing Co., 4600 Schubert Ave., Chicago
Ahlberg Bearing Co., 3025 W. 47th, Chicago
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
**Boston Gear Works, Inc., North Quincy, Mass.**
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Joy Ball Bearing Corp., 4550 W. Fulton, Chicago
Landis & Gyr, Inc., 104 Fifth Ave., New York (miniature sizes)
**Marlin-Rockwell Corp., Jamestown, N. Y.**
**McGill Mfg. Co., Valparaiso, Ind.**
**New Departure, Div. General Motors, Bristol, Conn.**
Nice Ball Bearing Co., Philadelphia, Pa.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Saginaw Stamping & Tool Co., 68 Williamson, Saginaw, Mich.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)

***For further information on companies listed***

**Torrington Co., Torrington, Conn.**
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, BALL, SELF ALIGNING**
Aetna Ball Bearing Mfg. Co., 4612 Schubert Ave., Chicago
Ahlberg Bearing Co., 3025 W. 47th, Chicago
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y.
Franklin Machine Co., 44 Cross, Providence, R. I.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Landis & Gyr, Inc., 104 Fifth Ave., New York (miniature sizes)
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)
**Standard Pressed Steel Co., Jenkintown, Pa.**
**Torrington Co., Torrington, Conn.**

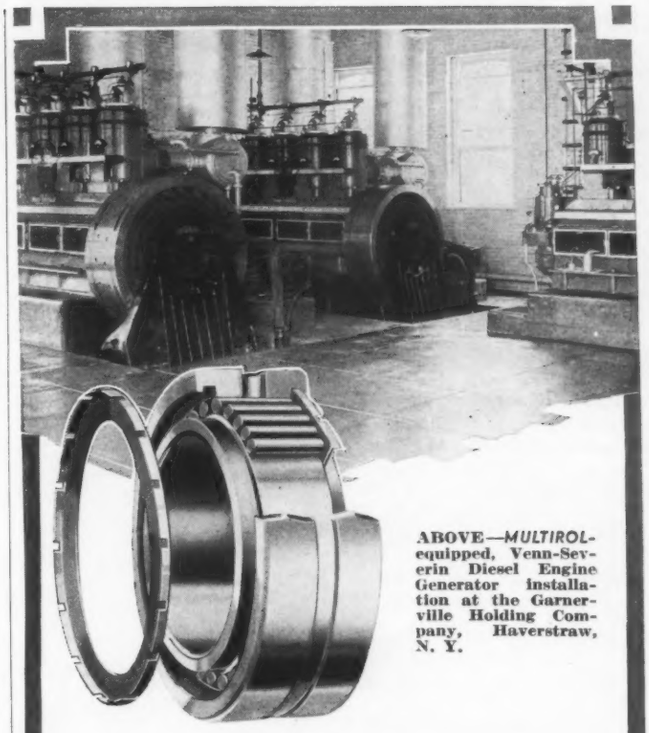
**BEARINGS, BALL, THRUST**
Aetna Ball Bearing Co., 4600 Schubert Ave., Chicago
Ahlberg Bearing Co., 3025 W. 47th, Chicago
American Roller Bearing Co., Pittsburgh, Pa.
Auburn Ball Bearing Co., Rochester, N. Y.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Bearings Corp. 3702 W. Sample, South Bend, Ind.
Bearings Company of America, Lancaster, Pa.
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
**Boston Gear Works, Inc., North Quincy, Mass.**
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y.
Gwilliam Co., The, 360 Furman, Brooklyn, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Joy Ball Bearing Corp., 4550 W. Fulton, Chicago
Landis & Gyr, Inc., 104 Fifth Ave., New York (Miniature sizes)
**Marlin-Rockwell Corp., Jamestown, N. Y.**
**McGill Mfg. Co., Valparaiso, Ind.**
Messinger Bearing Co., Philadelphia, Pa.
Federal-Mogul Corp., Detroit
Nice Ball Bearing Co., Philadelphia, Pa.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Schatz Mfg. Co., Poughkeepsie, N. Y.
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)
**Torrington Co., Torrington, Conn.**
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, JEWEL**
Diamond Cupped Bearing Co.. 600 W. 125, New York
Waltham Watch Co., Waltham, Mass.
Worley, John, Jewel Co., Waltham, Mass.

**BEARINGS, NEEDLE**
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Heim Co., Fairfield, Conn.
**McGill Mfg. Co., Valparaiso, Ind.**
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Orange Roller Bearing Co., Inc., 557 Main, Orange, N. J.
Roller Bearing Co. of America, Trenton, N. J.
**Torrington Co., Torrington, Conn.**

**BEARINGS, PILLOW BLOCK**
Ahlberg Bearing Co., 3025 W. 47th, Chicago
American Roller Bearing Co., 416 Melwood, Pittsburgh, Pa.
Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
**Bunting Brass & Bronze Co., Toledo, Ohio**
Dick, R. & J., Co., Passaic, N. J.
Dodge Mfg. Corp., Mishawaka, Ind.
Fafnir Bearing Co., Booth St., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
Hoover Ball & Bearing Co., Ann Arbor, Mich.
**Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.**
**McGill Mfg. Co., Valparaiso, Ind.**
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Moraine Products Div., General Motors Corp., Dayton, Ohio
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Palmer-Bee Co., Detroit, Mich.
Penney, J. W., & Sons Co., 16 Maple, Mechanic Falls, Me.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Royersford Foundry & Machine Co., Royersford, Pa.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.

***in bold face type, see index on last page***



ABOVE—*MULTIROL*-equipped, Venn-Severin Diesel Engine Generator installation at the Garnerville Holding Company, Haverstraw, N. Y.

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McGILL

*MULTIROL*

**Precision Needle Bearings**

Eliminate bearing troubles and replacements and you go a long way toward truly uninterrupted service, whether it be sewing machines, Diesel engines or steam locomotives. McGILL *MULTIROL* Precision Bearings show finest records in these respects, have ever since they were introduced as the original needle type nine years ago. Especially under sustained heavy or intermittent shock loads, their great load capacity in proportion to their overall size enables them to far outrun plain bearings and ordinary anti-friction types in many uses.

Stocked in many standard sizes from ⅝ to 6-inch bore, single and double rows of rollers, at low, volume production prices. Corrosion, heat resisting and special designs to order. Send for Bulletin No. 37.

McGILL MANUFACTURING CO.
Bearing Division, 750 N. Lafayette St.
VALPARAISO, IND

**BEARINGS, PILLOW BLOCK (cont)**
Split Ballbearing Corp., Lebanon, N. H. (split type and solid miniature)
**Standard Pressed Steel Co., Jenkintown, Pa.**
Stephens-Adamson Mfg. Co., 530 Ridgeway, Aurora, Ill.
Woods, T. B., Sons Co., Chambersburg, Pa.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Winona Machine & Foundry Co., 62 Washington, Winona, Minn.

**BEARINGS, ROLLER, PLAIN AXIAL**
American Roller Bearing Co., 416 Melwood, Pittsburg, Pa.
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
Fafnir Bearing Co., Booth St., New Britain, Conn.
Gwilliam Co., The, 360 Furman, Brooklyn, N. Y.
Heim Co., Fairfield, Conn.
Hyatt Bearings Div. General Motors, Harrison, N. J.
**McGill Mfg. Co., Valparaiso, Ind.**
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Orange Roller Bearing Co., Inc. 557 Main, Orange, N. J.
Palmer-Bee Co., Detroit, Mich.
Roller Bearing Co. of America, Trenton, N. J.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type)

**BEARINGS, ROLLER, RADIAL AND THRUST COMBINED**
American Roller Bearing Co., 416 Melwood, Pittsburgh, Pa.
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
**McGill Mfg. Co., Valparaiso, Ind.**
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Orange Roller Bearing Co., Inc., 557 Mann, Orange, N. J.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type)
Timken Roller Bearing Co., Canton, Ohio
Tyson Roller Bearing Corp., Massillon, Ohio

**BEARINGS, ROLLER, SELF ALIGNING**
American Roller Bearing Co., 416 Melwood, Pittsburgh, Pa.
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Joy Ball Bearing Corp., 4550 Fulton, Chicago
Messinger Bearing Co., Philadelphia, Pa.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Orange Roller Bearing Co., Inc., 557 Main, Orange, N. J.
Palmer-Bee Co., Detroit, Mich.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
SKF Industries, Inc., Front & Erie Ave., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H. (split type)
Timken Roller Bearing Co., Canton, Ohio

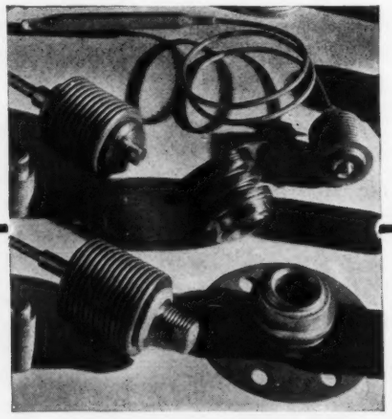
**BEARINGS, ROLLER, TAPERED**
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Orange Roller Bearing Co., Inc., 557 Main, Orange, N. J.
Timken Roller Bearing Co., Canton, Ohio
Tyson Roller Bearing Co., Massillon, Ohio
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, ROLLER, THRUST *(Step Type)***
American Roller Bearing Co., 416 Melwood, Pittsburgh, Pa.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Bearings Corp., 3702 W. Sample, South Bend, Ind.
Bearings Industry Corp., 1834 Broadway, New York, N. Y.
Gwilliam Co., The, 360 Furman, Brooklyn, N. Y.
Joy Ball Bearing Corp., 4550 Fulton, Chicago
Orange Roller Bearing Co., Inc., 557 Main, Orange, N. J.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago
Timken Roller Bearing Co., Canton, Ohio
Tyson Roller Bearing Corp., Massillon, Ohio
Western Bearings Co., 3020 Calumet, Chicago

**BEARINGS, SLEEVE TYPE**
*Babbitt Faced, Bronze Backed*
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit.
**Bunting Brass & Bronze Co., Toledo, Ohio**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Detroit Aluminum & Brass Corp., 3975 Christopher Ave., Detroit.
Federal-Mogul Corp., Detroit
Franklin Machine Co., 44 Cross, Providence, R. I.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Kingsbury Machine Works, Inc., 4324 Tackawanna, Philadelphia, Pa.
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Sumner Iron Works, Everett, Wash.

**BEARINGS, SLEEVE TYPE**
*Babbitt Faced, Steel Backed*
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit.
Detroit Aluminum & Brass Corp., 3975 Christopher Ave., Detroit.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Kingsbury Machine Works, Inc., 4324 Tackawanna, Philadelphia, Pa.
Moraine Products Div., General Motors Corp., Dayton, Ohio.
Royersford Foundry & Machine Co., Royersford, Pa.
**Standard Pressed Steel Co., Jenkintown, Pa.**
Sumner Iron Works, Everett, Wash.

**BEARINGS, SLEEVE TYPE**
*Bushings of Non-Ferrous Alloys*
Allan, A., & Son, 6th & Bergen Sts., Harrison, N. J.
American Castings Co., 2140 Freeman Ave., Cincinnati.
American Crucible Products Co., Lorain, Ohio.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit.
**Boston Gear Works, Inc., North Quincy, Mass.**
**Bunting Brass & Bronze Co., Toledo, Ohio**
Carlyle Johnson Machine Co., Manchester, Conn.
Chryler Corp.-Amplex Div., 6501 Harper Ave., Detroit
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Detroit Aluminum & Brass Corp., Detroit, Mich.
Federal-Mogul Corp., Detroit
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Moraine Products Div., General Motors Corp., Dayton, Ohio.
Penn Machine Co., 106 Station, Johnstown, Pa.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Shenango-Penn. Mold Co., Dover, Ohio
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Sumner Iron Works, Everett, Wash.



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BRIDGEPORT THERMOSTAT COMPANY, INC., Bridgeport, Conn.

5251 General Motors Bldg., Detroit, Mich. 30 N. La Salle St., Chicago, Ill.

*For further information on companies listed*

**BEARINGS, SLEEVE TYPE**
*Graphite and Oil Impregnated Metal*
**Boston Gear Works, Inc., North Quincy, Mass.**
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Bunting Brass & Bronze Co., Toledo, Ohio**
Chrysler Corp. — Amplex Div., 6501 Harper Ave., Detroit
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Hill Clutch Machine & Foundry Co., Cleveland, Ohio.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Moccasin Bushing Co., Chattanooga, Tenn.
Moraine Products Div., General Motors Corp., Dayton, Ohio.
National Carbon Co., Box 6087, Cleveland, Ohio
Randall-Graphite Products Co., 609 W. Lake, Chicago
**United States Graphite Co., Saginaw, Mich.**

**BEARINGS, SLEEVE TYPE, WOOD**
*Lignum Vitae*
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Hill Clutch Machine & Foundry Co., Cleveland, Ohio.
Lignum-Vitae Products Corp., 98 Boyd Ave., Jersey City, N. J.

**BEARINGS, THRUST, PIVOT SHOE**
Kingsbury Machine Works, 4324 Tackawanna, Philadelphia, Pa.

**BELLOWS, SEAMLESS METAL**
*For use as pressure diaphragms, thermostat members, expansion joints and chambers, flexible seals, packless glands, dust guards or shock dampeners.*
**Bridgeport Thermostat Co., Bridgeport, Conn.**
**Clifford Mfg. Co., Boston, Mass.**
**Fulton Sylphon Co., Knoxville, Tenn.**

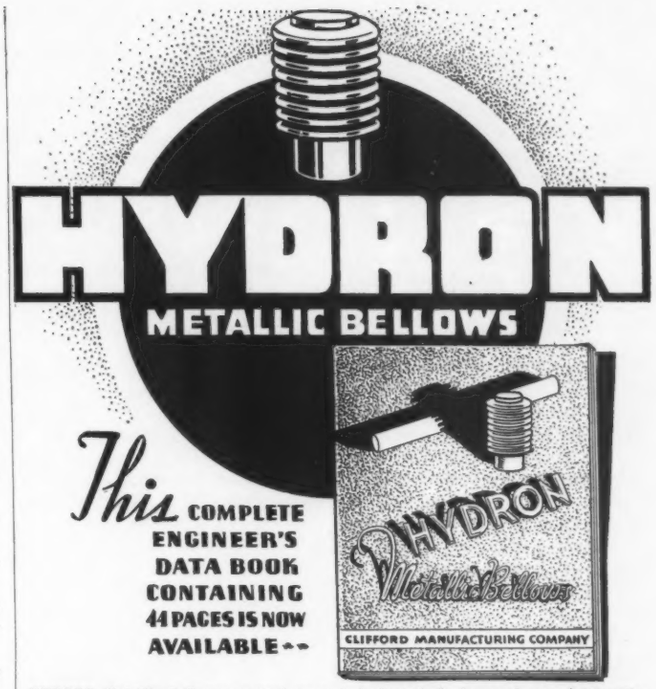
**BELTS, FLAT LEATHER**
Alexander Brothers, 406 N. Third, Philadelphia, Pa.
Auburn Mfg. Co., Middletown, Conn.
Bonner & Barnewall, Inc., 92 Bleecker, New York.
Chicago Belting Co., 117 N. Green, Chicago.
**Graton & Knight Co., Worcester, Mass.**
Houghton, E. F., & Co., 240 W. Somerset, Philadelphia, Pa.
National Leather Belting Co., Inc., 34–44 Hubert, New York.
Rhoads, J. E., & Sons, 35 N. 6th, Philadelphia, Pa.
Warren Belting Co., Worcester, Mass.

**BELTS, FLAT RUBBER AND FABRIC**
Allen, W. D., Mfg. Co., 566 W. Lake, Chicago
Bonner & Barnewall, Inc., 92 Bleecker, New York.
Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge, Mass.
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Continental Rubber Works, 1902 Liberty, Erie, Pa.
Dick, R. & J., Co., Passaic, N. J.
**DuPont de Nemours & Co., Inc., Wilmington, Del.**
**Garlock Packing Co., The, Palmyra, N. Y.**
Gates Rubber Co., The, 999 S. Broadway, Denver, Colo.
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
Goodrich, B. F., Co., 522 S. Main, Akron, Ohio
Goodyear Tire & Rubber Co., E. Market, Akron, Ohio.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Manheim Mfg. & Belting Co., Manheim, Pa.
Quaker City Rubber Co., Comly & Milnor, Philadelphia, Pa.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio.
Thermoid Rubber Div., Thermoid Co., Trenton, N. J.
United States Rubber Products, Inc., 1790 Broadway, New York

**BELTS, FLAT, STEEL MESH**
*(See Wire Cloth, Woven)*

**BELTS, V-TYPE**
Allen, W. D., Mfg. Co., 566 W. Lake, Chicago
Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.
Bonner & Barnewall, Inc., 92 Bleecker, New York.
**Boston Gear Works, Inc., North Quincy, Mass.**
Chicago Belting Co., 117 N. Green, Chicago.
Continental Rubber Works, 1902 Liberty, Erie, Pa.
Dayton Rubber Mfg. Co., Dayton, Ohio.
Dick, R. & J., Co., Passaic, N. J.
Dodge Mfg. Corp., Mishawaka, Ind.
**DuPont de Nemours & Co., Inc., Wilmington, Del.**
Firestone Tire & Rubber Co., Akron, Ohio
Gates Rubber Co., The, 999 S. Broadway, Denver, Colo.
Gilmer, L. H., Co., Tacony, Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
Goodrich, B. F., Co., 522 S. Main, Akron, Ohio.
Goodyear Tire & Rubber Co., E. Market, Akron, Ohio.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.

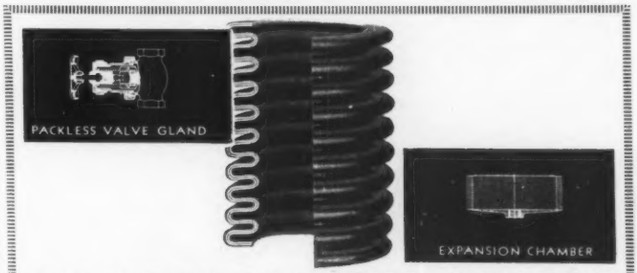
*in bold face type, see index on last page*


HYDRON Metallic Bellows are used as control elements in temperature-and-pressure-control devices, and for liquid or gas seals of compressors and pumps. We are specialists in the design and production of complete thermostatic and pressure units for temperature and pressure controls. We are, therefore, prepared to extend the fullest co-operation to engineering departments of control manufacturers in the solution of design and engineering problems.

**CLIFFORD MANUFACTURING CO.**

564 East First Street, Boston, Mass. Chicago, Detroit, Los Angeles
PRODUCERS OF BELLOWS EXCLUSIVELY
SERVING AUTOMATIC CONTROL MANUFACTURERS

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**The FULTON SYLPHON CO.**
KNOXVILLE, TENN.

**BELTS, V-TYPE (Cont.)**
Manheim Mfg. & Belting Co., Manheim, Pa.
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
National Leather Belting Co., Inc., 34–44 Hubert, New York.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio.
Thermoid Rubber Div., Thermoid Co., Trenton, N. J.
United States Rubber Products, Inc., 1790 Broadway, New York.
Wood's, T. B., Sons Co., Chambersburg, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

**BI-METAL FOR THERMOSTATIC ELEMENTS**
*Bars, Strips, Tubes or Wire*
Baker & Co., Inc., 113 Astor, Newark, N. J.
**Callite Products Co., Union City, N. J.**
**Chace, W. M., Co., Detroit, Mich.**
**General Plate Co., 40 Forest, Attleboro, Mass.**
**Wilson, H. A., Co., 105 Chestnut, Newark, N. J.**

**BOLTS, EXPANSION**
Ames, W., & Co., Jersey City, N. J.
Bethlehem Steel Corp., Bethlehem, Pa.
Boss Bolt & Nut Co., 3403 W. 47th, Chicago.
Diamond Expansion Bolt Co., 90 West, New York.
Erie Malleable Iron Co., Erie, Pa.
Hubbard & Co., Pittsburgh, Pa.
Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.
Maryland Bolt & Nut Co., Baltimore, Md.
Nelson, N. O., Mfg. Co., St. Louis, Mo.
Oliver Iron & Steel Corp., Pittsburgh, Pa.
Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.
Rawlplug Co., Inc., 98 Lafayette, New York.
Republic Steel Corp., Cleveland, Ohio.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Star Expansion Bolt Co., Bayonne, N. J.
St. Louis Screw & Bolt Co., St. Louis, Mo.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
United States Expansion Bolt Co., 75 Varick, New York.

**BOLTS, EYE AND HOOK**
**American Chain Co., Inc., Bridgeport, Conn.**
Armstrong Bros. Tool Co., 375 N. Francisco Ave., Chicago.
Beaird, J. B. Corp., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Billings & Spencer Co., 1 Laurel, Hartford, Conn.
Boss Bolt & Nut Co., 3403 W. 47th, Chicago.
Bridgeport Chain & Mfg. Co., Bridgeport, Conn.
Brooks, M. S., & Sons, Inc., Chester, Conn.
Buffalo Bolt Co., North Tonawanda, N. Y.
Clark Bros. Bolt Co., Milldale, Conn.
Cleveland City Forge Co., Cleveland, Ohio.
Cleveland Hardware & Forging Co., 3270 E. 79th, Cleveland, Ohio.
Columbus Bolt Works, Co., Columbus, Ohio.
Dardalet Threadlock Corp., 55 Liberty, New York
Haskell, Wm. H., Mfg. Co., 24 Commerce, Pawtucket, R. I.
Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.
**Lamson & Sessions Co., Cleveland, Ohio**
Laughlin Thomas Co., Portland, Me.
Maryland Bolt & Nut Co., Baltimore, Md.
Milton Mfg. Co., Milton, Pa.
National Screw & Mfg. Co., 2440 E. 75th Cleveland Ohio.
Neely Nut & Bolt Co., Pittsburgh, Pa.
New England Bolt Co., Inc., Everett, Mass.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Pacific Coast Steel Corp., San Francisco, Calif.
Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio.
Rockford Bolt & Steel Co., 126 Mill, Rockford, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
St. Louis Screw & Bolt Co., 6900 N. Broadway, St. Louis, Mo.
Washburn Co., Worcester, Mass.
**Williams, J. H., & Co., 460 Vulcan, Buffalo, N. Y.**

**BOLTS, RIB**
*With shank fluted to prevent turning in hole*
Automatic Nut Co., Lebanonn, Pa.

**BOLTS, SCREWS AND NUTS**
*Non-Ferrous Materials*
**American Brass Co., Waterbury, Conn.**
**American Screw Co., Providence, R. I.**
**Ampco Metal Co., Inc., 3830 W. Burnham, Milwaukee, Wis.**
Atlas Bolt & Screw Co., Cleveland, Ohio.
Barnes, Wallace, Co., Bristol, Conn.
Bayonne Bolt Corp., Bayonne, N. J.
Blake & Johnson Co., Waterville, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Burgess-Parr Co., Freeport, Ill.
Central Screw Co., 3501 Shields Ave., Chicago.
Chase Brass & Copper Co., Waterbury, Conn.
Chicago Screw Co., 1026 S. Homan Ave., Chicago.
Clark Bros Bolt Co., Milldale, Conn.
Cleveland Cap Screw Co., 2917 E. 79th, Cleveland, Ohio
Conklin, T. E., Brass & Copper Co., 76 Lafayette, New York.
**Continental Screw Co., 459 Mt. Pleasant, New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
Dardelet Threadlock Corp., 55 Liberty, New York
Eastern Machine Screw Corp., New Haven, Conn.
Economy Screw Corp., Greenview Ave., Chicago.
Elco Tool & Screw Corp., 1800 Broadway, Rockford, Ill.
Harper, H. M., Co., 2620 Fletcher, Chicago.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Haskell, Wm. H. Mfg. Co., 24 Commerce, Pawtucket, R. I.
**Lamson & Sessions Co., Cleveland, Ohio**
Maryland Bolt & Nut Co., Baltimore, Md.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
**National Screw & Mfg. Co., 2440 E. 75th, Cleveland, Ohio.**
New England Bolt Co., Inc., Everett, Mass.
Oliver Iron & Steel Corp., Pittsburgh, Pa.
Ottemiller, Wm. H., Co., York, Pa.
Pawtucket Mfg. Co. Pawtucket, R. I.
**Peck Spring Co., Plainville, Conn.**
Pheoll Mfg. Co., 5700 Roosevelt Road, Chicago.
Progressive Mfg. Co., Torrington, Conn.
Reading Screw Co., Norristown, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York
Rochester Machine Screw Co., Rochester, N. Y.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
St. Louis Screw & Bolt Co., 6900 N. Broadway, St. Louis, Mo.
**Scovill Mfg. Co., Waterbury, Conn.**
Spaulding Fibre Co., Inc., 310 Wheeler, Tonawanda, N. Y. (Fiber)
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio.

**BOLTS, SCREWS AND NUTS**
*Iron and Steel*
**American Screw Co., Providence, R. I.**
Atlas Bolt & Screw Co., 1130 Ivanhoe Rd., Cleveland, Ohio.
Bayonne Bolt Corp., Bayonne, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Bolt & Nut Co., North Tonawanda, N. Y.
Central Screw Co., 3501 Shields Ave., Chicago.
Chicago Screw Co., 1026 S. Homan Ave., Chicago.
Clark Bros. Bolt Co., Milldale, Conn.
Cleveland Cap Screw Co., 2917 E. 79th, Cleveland, Ohio
**Continental Screw Co., 459 Mt. Pleasant, New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
Dardelet Threadlock Corp., 55 Liberty, New York
Elco Tool & Screw Corp., 1800 Broadway, Rockford, Ill.
Federal Screw Works, 3401 Martin Ave., Detroit, Mich.
Ferry Cap & Set Screw Co., Cleveland, Ohio.
Hartford Machine Screw Co., 476 Capitol Ave., Hartford, Conn.
Haskell, Wm. H., Mfg. Co., 24 Commerce, Pawtucket, R. I.
**Lamson & Sessions Co., Cleveland, Ohio**
Milton Mfg. Co. Milton Pa.
Muncie Cap & Set Screw Co., Muncie, Ind.
**National Lock Co., Rockford, Ill.**
National Screw & Mfg. Co., 2440 E. 75th, Cleveland, Ohio.
Neeley Nut & Bolt Co., Pittsburgh, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Ottemiller, Wm. H., Co. York Pa.
Pettibone Mulliken Corp., 4710 W. Division, Chicago.
Pheoll Mfg. Co. 5700 Roosevelt Road, Chicago.
Reading Screw Co., Norristown, Pa.
Reed & Prince Mfg. Co., Worcester, Mass.
Republic Steel Corp., Cleveland, Ohio.
Rochester Machine Screw Co., Rochester, N. Y.
Russell, Burdsall & Ward Bolt & Nut Co. Port Chester, N. Y.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago.
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
St. Louis Screw & Bolt Co., 6900 N. Broadway, St. Louis, Mo.
Triplex Screw Co., 5319 Grand Ave., Cleveland Ohio.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio.

**BOLTS, WELDING**
*Made with projections for resistance welding to sheets*
Ohio Bolt & Nut Co., 600 Front, Berea, Ohio

***For further information on companies listed***

### BONDED METALS, PREFINISHED

*(see also Plates, Nickel Clad Steel and Bi-metal)*

American Nickeloid Co., Peru, Ill.
Appollo Metal Works, 6601 S. Oak Park Ave., Chicago
Berger Brothers Co., 229 Arch, Philadelphia, Pa.
Bishop & Co., J., Platinum Works, 12 Channing Ave., Malvern, Pa.
**General Plate Co., 40 Forest, Attleboro, Mass.**
**Haskelite Mfg. Corp., 208 W. Washington, Chicago (aluminum and steel on wood)**

### BRAKES, MAGNETIC

*Magnetically or solenoid operated brakes, band or disk type*

Century Electric Co., St. Louis, Mo.
Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Dings Magnetic Separator Co., Milwaukee, Wis.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Electric Specialties Co., Stamford, Conn.
**General Electric Co., Schenectady, N. Y.**
Harnischfeger Corp., Milwaukee, Wis.
Star Electric Motor Co., Bloomfield, N. J.
Stearns Magnetic Mfg. Co., 631 S. 28th, Milwaukee, Wis.
Watson-Flagg Machine Co., Inc., 845 E. 25th, Paterson, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### BRAZING COMPOUNDS & FLUXES

Air Reduction Sales Co., 60 E. 42nd, New York
American Chemical Paint Co., Ambler, Pa.
Atkins, E. C., & Co., 402 S. Illinois, Indianapolis, Ind.
Belmont Smelting & Refining Works, Inc., 807 Belmont Ave., Brooklyn, N. Y.
Fansteel Metallurgical Corp., North Chicago, Ill.
Handy & Harman, 82 Fulton, New York
Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago
Linde Air Products Co., 205 E. 42nd, New York
Mallory, P. R., & Co., Inc., Indianapolis, Ind.
Plouff Co., 1150 Columbus Ave., Boston, Mass.

### BREAKERS, CIRCUIT

*Air circuit breakers, not operated in oil*

**Allis-Chalmers Mfg. Co., 1126 S. 70th, Milwaukee, Wis.**
Arrow-Hart & Hegeman Electric Co., Hartford, Conn.
Automatic Reclosing Circuit Breaker Co., Columbus, Ohio
Automatic Switch Co., Detroit, Mich.
Bryant Electric Co., Bridgeport, Conn.
Colt's Patent Fire Arms Co., Hartford, Conn.
Condit Electrical Mfg. Corp., Hyde Park, Boston, Mass.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Delta-Star Electric Co., 2400 Fulton, Chicago
**General Electric Co., Bridgeport, Conn.**
Hart Mfg. Co., Hartford, Conn.
Heinemann Electric Co., Trenton, N. J.
Pacific Electric Mfg. Corp., San Francisco, Calif.
Roller-Smith Co., 233 Broadway, New York
Sangamo Electric Co., Springfield, Ill.
**Square D Co., 710 S. 3rd, Milwaukee, Wis.**
**Square D Co., 6060 Rivard, Detroit, Mich.**
Trumbull Electric Mfg. Co., Plainville, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### BUSHINGS, BRONZE

*For bearings, gears and pulleys*

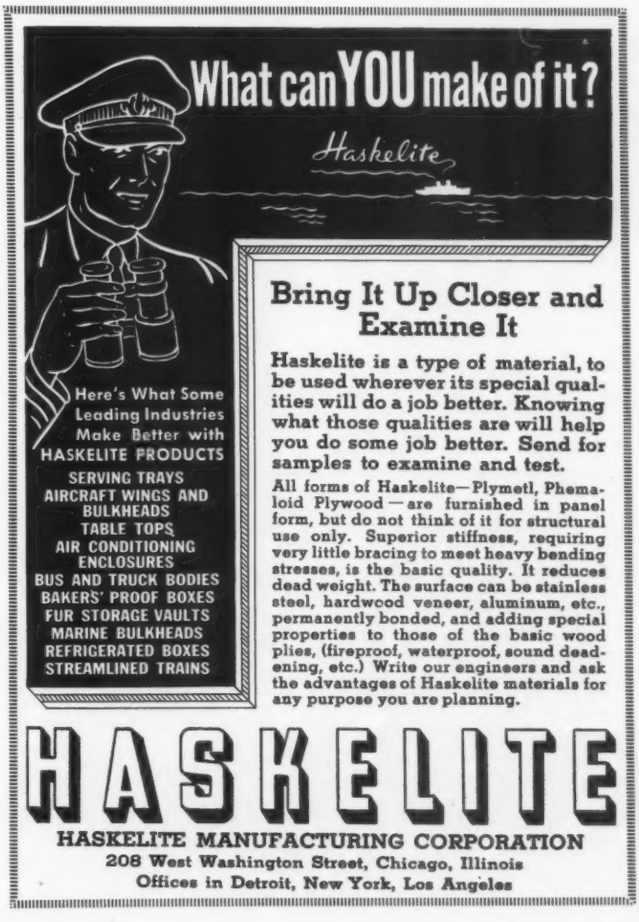
Ajax Metal Co., Philadelphia, Pa.
Allan, A., & Son, 6th & Bergen Sts., Harrison, N. J.
Aluminum Industries, Inc., 2416 Beekman, Cincinnati, Ohio
American Bearing Corp., 420 S. Harding, Indianapolis, Ind.
**American Brass Co., Waterbury, Conn.**
American Manganese Bronze Co., Holmesburg, Pa.
American Smelting & Refining Co., 120 Broadway, New York
**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Amplex Div., Chrysler Corp., 6501 Harper Ave., Detroit, Mich.
Beaird, J. B. Corp., Shreveport, La.
Belmont Smelting & Refining Works, Inc., 807 Belmont Ave., Brooklyn, N. Y.
Bohn Alumbinum & Brass Corp., Detroit, Mich.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Bunting Brass & Bronze Co., Toledo, Ohio**
Central Brass & Aluminum Foundry Co., Cincinnati, O.
Conklin, T. E., Brass & Copper Co., 76 Lafayette, New York
**Cramp Brass & Iron Foundries, Philadelphia, Pa.**
Detroit Aluminum & Brass Corp., Detroit, Mich.
Enterprise Fdry. Corp., 710 Division, S. San Francisco, Calif.
Federal-Mogul Corp., Detroit
Frontier Products Corp., Mineral Ridge, Ohio
Green Bay Foundry & Machine Works, Green Bay, Wis.
Jeffrey Mfg. Co., Columbus, Ohio
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Johnson, Carlyle, Machine Co., Manchester, Conn.
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Magnolia Metal Co., Elizabeth, N. J.
**McGill Mfg. Co., Valparaiso, Ind.**
Moccasin Bushing Co., Chattanooga, Tenn.
Moraine Products Div., General Motors Corp., Dayton, Ohio
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Penn Machine Co., 106 Station, Johnston, Pa.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Randall Graphite Products Corp., 609 W. Lake, Chicago
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Shenango-Penn Mold Co., Dover, Ohio
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Sumner Iron Works, Everett, Wash.
Thompson Products, Inc., Cleveland, Ohio
Waltham Watch Co., Waltham, Mass.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.
Wood's, T. B., Sons Co., Chambersburg, Pa.

### BUSHINGS, OILLESS

*For bearings, gears and pulleys*

American Crucible Products Co., Lorain, Ohio
Amplex Division, Chrysler Corp., 6501 Harper Ave., Detroit, Mich.
**Boston Gear Works, Inc., North Quincy, Mass.**
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Bunting Brass & Bronze Co., Toledo, Ohio**
Enterprise Fdry Corp., 710 Division, S. San Francisco, Calif.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Johnson, Carlyle, Machine Co., Manchester, Conn.
Moccasin Bushing Co., Chattanooga, Tenn.
Moraine Products Div., General Motors Corp., Dayton, Ohio

*in bold face type, see index on last page*



What can YOU make of it?
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HASKELITE
HASKELITE MANUFACTURING CORPORATION
208 West Washington Street, Chicago, Illinois
Offices in Detroit, New York, Los Angeles

### BUSHINGS, OILLESS

*For bearings, gears and pulleys (Cont.)*

Neveroil Bearing Co., Wakefield, Mass.
Nolu Oilless Bearing Co., Philadelphia, Pa.
Spaulding Fibre Co., Inc., 310 Wheeler, Tonawanda, N. Y.
Synthane Corp., Oaks, Pa.
Thompson Products, Inc., Cleveland, Ohio

### BUSHINGS, FIBER

*(see Fiber, Vulcanized)*

### CABINET FITTINGS

*Hinges, latches, locks, door bolts and special fittings*

Corbin Cabinet Lock Co., New Britain, Conn.
Corbin, P. & F., New Birtain, Conn.
Grammes, L. F. & Sons, Inc., Allentown, Pa.
Griffin Mfg. Co., Erie, Pa. (hinges)
Illinois Lock Co., 735 W. Jackson Blvd., Chicago
McKinney Mfg. Co., Pittsburgh, Pa.
Milwaukee Stamping Co., Milwaukee, Wis.
National Brass Co., 1601 Madison Ave., Grand Rapids, Mich.
Richard-Wilcox Mfg. Co., Aurora, Ill.
Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Greenleaf, Inc., Rochester, N. Y.
Sessions, J. H. & Son, Bristol, Conn.
Shelby Spring Hinge Co., Shelby, Ohio

### CASTERS, WHEELS

*Metallic and non-metallic, plain and ball bearing mounted*

Bassick Co., The, Bridgeport, Conn.
Bond Foundry & Machine Co., Manheim, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Clark, Geo. P., Co., Windsor Locks, Conn.
Darnell Corp., Ltd., 3517 E. 11th, Los Angeles, Calif.
Divine Bros. Co., Utica, N. Y.
Fairbanks Co., 303 Lafayette, New York
Faultless Caster Corp., Evansville, Ind.
Formica Insulation Co., 4620 Spring Grove Ave., Cincinnati, Ohio
Goodrich, B. F., Co., 522 S. Main, Akron, Ohio
Hamilton Caster & Mfg. Co., Hamilton, Ohio
Jarvis & Jarvis, Inc., Palmer, Mass.
Kilian Mfg. Corp., 107 N. Franklin, Syracuse, N. Y.
Mercury Mfg. Co., 4044 S. Halsted, Chicago
**Musselman Products Co., 6308 St. Clair, Cleveland, Ohio**
Phoenix Caster Co., Inc., Hamilton, Ohio
Saginaw Stamping & Tool Co., Saginaw, Mich.
Service Caster & Truck Co., Albion, Mich.
Spaulding Fibre Co., Inc., 310 Wheeler, Tonawanda, N. Y.
Sumner Iron Wks., Everett, Wash.
**Transue & Williams Steel Forging Corp., Alliance, Ohio (drop forged)**
Wilmington Fibre Specialty Co., East Wilmington, Del.

### CASTINGS, ALUMINUM BRONZE

**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Beaird, J. B., Corp., Shreveport, La.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Buckeye Iron & Brass Works, 324 E. Third, Dayton, Ohio
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Delta-Star Electric Co., 2400 Fulton, Chicago
Duriron Co., Inc., Dayton, Ohio
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Eastern Malleable Iron Co., Naugatuck, Conn.
Eastern Malleable Iron Co., Wilmington, Del.
Enterprise Fdry. Corp., 710 Division St., San Francisco, Calif.
Federal-Mogul Corp., Detroit, Mich.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Frontier Products Corp., Mineral Ridge, Ohio
Green Bay Foundry & Machine Works, Green Bay, Wis.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Hunter, James, Machine Co., North Adams, Mass.
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Shenango-Penn Mold Co., Dover, Ohio
Sumner Iron Wks., Everett, Wash.
Superior Bronze Corp., Erie, Pa.
Union Switch & Signal, Swissvale, Pa.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

### CASTINGS, ALUMINUM DIE-CASTINGS

*(see also Die-Castings)*

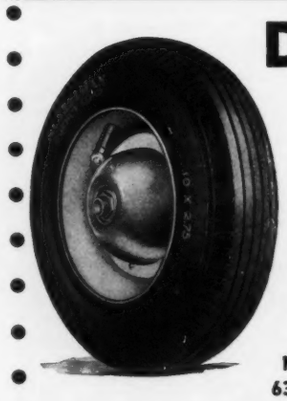
Advance Pressure Castings, Inc., 50 N. 15th, Brooklyn, N. Y.
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
Badger Die Casting Co., 1574 S. First, Milwaukee, Wis.
Cleveland Hardware & Forging Co., 3270 E. 79th, Cleveland, Ohio
Dollin Corp., 606 S. 21st, Irvington, N. J.
Doehler Die-Casting Co., Toledo, Ohio
Hoover Co., Maple St., North Canton, Ohio
Latrobe Die-Casting Co., Latrobe, Pa.
Phoenix Die Casting Co., 21 Illinois, Buffalo, N. Y.
Pressure Castings, Inc., 21500 St. Clair Ave, Cleveland, Ohio
Sumner Iron Wks., Everett, Wash.
Titan Metal Mfg. Co., Bellefonte, Pa.

### CASTINGS, ALUMINUM PERMANENT MOLD

Advance Pressure Castings, Inc., 50 N. 15th, Brooklyn, N. Y.
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
Aluminum Industries, Inc., 2416 Beekman, Cincinnati, Ohio
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Dollin Corp., 606 S. 21st, Irvington, N. J.
Eaton Mfg. Co., 739 E. 140th, Cleveland, Ohio
Nicralumin Co., 146 W. Cortland, Jackson, Mich.
Sumner Iron Wks., Everett, Wash.
Thompson Products, Inc., Cleveland, Ohio

### CASTINGS, ALUMINUM SAND

Aluminum Industries, Inc., 2416 Beekman, Cincinnati, Ohio
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
Beaird, J. B., Corp., Shreveport, La.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Buckeye Iron & Brass Works, 324 E. Third, Dayton, Ohio
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Chemung Foundry Corp., Elmira, N. Y.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Dedman Foundry & Machine Co., Houston, Tex.
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Enterprise Fdry. Corp., 710 Division St., San Francisco, Cal.
Frontier Products Corp., Mineral Ridge, Ohio
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Hunter, James, Machine Co., North Adams, Mass.
Kelly Foundry & Machine Co., Elkins, West Va.
Lakeside Malleable Castings Co., Racine, Wis.
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Nicralumin Co., 146 W. Cortland, Jackson, Mich.



**DOENUT WHEELS**

U. S. Patent No. 2015459

Designed and engineered to absorb surface obstructions and eliminate jolts. Will not sink into sand or soft ground. Operate on as low as 15 lbs. air pressure. Guaranteed to have less rolling resistance than any other tire built for similar purposes. Single tube cords, sizes 10"x2¾" and 12"x3.30". Cadmium plated steel disc wheel with adjustable ball bearings and knock-out type axle. Developed by the inventor of the air-wheel for airplanes. Literature and prices on request.

**MUSSELMAN PRODUCTS CO.**
**6308 St. Clair Ave., Cleveland, O.**

*For further information on companies listed*

Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Sumner Iron Wks., Everett, Wash.
Superior Bronze Corp., Erie, Pa.
Turner & Seymour Mfg. Co., Torrington, Conn.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

## CASTINGS, BERYLLIUM COPPER

*(see also Copper, Beryllium)*

**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Delta-Star Electric Co., 2400 Fulton, Chicago
Enterprise Fdry. Corp., 710 Division St., San Francisco, Cal.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Frontier Products Corp., Mineral Ridge, Ohio
Sumner Iron Wks., Everett, Wash.
Superior Bronze Corp., Erie, Pa.
United Metals, 620 Hamilton, Spokane, Wash.

## CASTINGS, BRASS AND BRONZE

American Crucible Products Co., Lorain, Ohio
**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Beaird, J. B., Corp., Shreveport, La.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Bunting Brass & Bronze Co., Toledo, Ohio**
Carbon Malleable Casting Co., Lancaster, Pa.
Chemung Foundry Corp., Elmira, N. Y.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Dole Valve Co., 1901-41 Carroll Ave., Chicago
Eastern Malleable Iron Co., Naugatuck, Conn.
Eastern Malleable Iron Co., Wilmington, Del.
Enterprise Fdry. Corp., 710 Division St., San Francisco, Cal.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Frontier Products Corp., Mineral Ridge, Ohio
Hoe, R., & Co., Inc., 910 E. 138th St., New York
Homestead Valve Mfg. Co., Coraopolis, Pa.
Hunter, James, Machine Co., North Adams, Mass.
Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago
Jamestown Iron Works, Inc., 20 Taylor, Jamestown, N. Y.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio
Penney, J. W. & Sons Co., 16 Maple, Mechanic Falls, Me.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Shenango-Penn Mold Co., Dover, Ohio
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Sumner Iron Wks., Everett, Wash.
Superior Bronze Corp., Erie, Pa.
Union Switch & Signal, Swissvale, Pa.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

## CASTINGS, BRONZE, HIGH LEAD

Allan, A. & Son, 6th & Bergen, Harrison, N. J.
American Crucible Products Co., Lorain, Ohio
**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
**Bunting Brass & Bronze Co., Toledo, Ohio**
Chemung Foundry Corp., Elmira, N. Y.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Delta Star-Electric Co., 2400 Fulton, Chicago
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Enterprise Fdry. Corp., 710 Division St., San Francisco, Cal.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Frontier Products Corp., Mineral Ridge, Ohio
Homestead Valve Mfg. Co., Coraopolis, Pa.
Hunter, James, Machine Co., North Adams, Mass.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearings Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Shenango-Penn Mold Co., Dover, Ohio
Sumner Iron Wks., Everett, Wash.
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Superior Bronze Corp., Erie, Pa.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

## CASTINGS, BRONZE, MANGANESE

Beaird, J. B.. Corp., Shreveport, La.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Chemung Foundry Corp., Elmira, N. Y.
Dole Valve Co., 1901-41 Carroll Ave., Chicago
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Enterprise Fdry. Corp., 710 Division St., San Francisco, Cal.
Federal-Mogul Corp., Detroit, Mich.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Frontier Products Corp., Mineral Ridge, Ohio
Homestead Valve Mfg. Co., Coraopolis, Pa.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearings Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.
Shenango-Penn Mold Co., Dover, Ohio
Sumner Iron Wks., Everett, Wash.
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
Superior Bronze Corp., Erie, Pa.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

## CASTINGS, BRONZE, PHOSPHOR

American Crucible Products Co., Lorain, Ohio
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Buckeye Iron & Brass Works, 324 E. Third, Dayton, Ohio
**Bunting Brass & Bronze Co., Toledo, Ohio**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Chemung Foundry Corp., Elmira, N. Y.
Dole Valve Co., 1901-41 Carroll Ave., Chicago
Enterprise Fdry. Corp., San Francisco, Cal.
Federal-Mogul Corp., Detroit, Mich.
Frontier Products Corp., Mineral Ridge, Ohio
Homestead Valve Mfg. Co., Coraopolis, Pa.
Hunter, James, Machine Co., North Adams, Mass.
**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**
Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.
Moccasin Bushing Co., Chattanooga, Tenn.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.
Phosphor Bronze Smelting Co., Philadelphia, Pa.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Shenango-Penn Mold Co., Dover, Ohio
Sumner Iron Wks., Everett, Wash.
Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.
United Metals, 620 Hamilton, Spokane, Wash.
M. G. Wilson & G. N. Nutwell, 140 Callish, Fresno, Calif.

***in bold face type, see index on last page***

### CASTINGS, BRONZE, SILICON

Bohn Aluminum & Brass Corp., 140 Lafayette Bldg., Detroit, Mich.

**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**

Dole Valve Co., 1901-41 Carroll Ave., Chicago

Enterprise Fdry. Corp., 710 Division, San Francisco, Cal.

Frontier Products Corp., Mineral Ridge, Ohio

Homestead Valve Mfg. Co., Coraopolis, Pa.

Hunter, James, Machine Co., North Adams, Mass.

**Johnson Bronze Co., 508 S. Mill, New Castle, Pa.**

Nathan Mfg. Co., 250 Park Ave., New York

Northern Pump Co., 920-18th Ave., N. E., Minneapolis, Minn.

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Shenango-Penn Mold Co., Dover, Ohio

Sumner Iron Wks., Everett, Wash.

Sumet Corp., 1543 Fillmore Ave., Buffalo, N. Y.

Union Switch & Signal, Swissvale, Pa.

United Metals, 620 Hamilton, Spokane, Wash.

### CASTINGS, COPPER-ALUMINUM-IRON

**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**

Beaird, J. B., Corp., Shreveport, La.

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.

**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**

Diecasters, Inc., 111-8th Ave., New York

Enterprise Fdry. Corp., 710 Division, San Francisco, Cal.

Frontier Products Corp., Mineral Ridge, Ohio

Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.

Homestead Valve Mfg. Co., Coraopolis, Pa.

Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.

Shenango-Penn Mold Co., Dover, Ohio

Sumner Iron Wks., Everett, Wash.

Superior Bronze Corp., Erie, Pa.

United Metals, 620 Hamilton, Spokane, Wash.

### CASTINGS, COPPER-NICKEL

Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J.

**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**

Chemung Foundry Corp., Elmira, N. Y.

Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.

Enterprise Fdry. Corp., 710 Division, San Francisco, Cal.

Frontier Products Corp., Mineral Ridge, Ohio

Homestead Valve Mfg. Co., Coraopolis, Pa.

Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.

National Bearing Metals Corp., 4930 Manchester Ave., St. Louis, Mo.

**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**

Shenango-Penn Mold Co., Dover, Ohio

Sumner Iron Wks., Everett, Wash.

United Metals, 620 Hamilton, Spokane, Wash.

Wilmington Casting Co., The, Wilmington, Del.

### CASTINGS, COPPER-SILICON

**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**

Chemung Foundry Corp., Elmira, N. Y.

Enterprise Fdry. Corp., 710 Division, San Francisco, Cal.

Frontier Products Corp., Mineral Ridge, Ohio

Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.

Homestead Valve Mfg. Co., Coraopolis, Pa.

Nathan Mfg. Co., 250 Park Ave., New York

Shenango-Penn Mold Co., Dover, Ohio

Sumner Iron Wks., Everett, Wash.

Superior Bronze Corp., Erie, Pa.

United Metals, 620 Hamilton, Spokane, Wash.

### CASTINGS, DIE

*(see Die Castings)*

### CASTINGS, IRON, ALLOY

(*See also Castings, Alloy Steel*)

*Iron castings, containing various alloys including nickel, chromium, molybdenum, for high temperature service and corrosion resistance.*

Allegheny Steel Co., Brackenbridge, Pa.

American Rolling Mill Co., Middletown, Ohio

Babcock & Wilcox Tube Co., Beaver Falls, Pa.

Bethlehem Steel Co., Bethlehem, Pa.

Buffalo Foundry & Machine Co., Buffalo, N. Y.

**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**

Cooper Alloy Foundry Co., Elizabeth, N. J.

**Cramp Brass & Iron Foundries, Philadelphia, Pa.**

Crucible Steel Co., New York, N. Y.

Driver-Harris Co., Harrison, N. J.

Duraloy Co., Pittsburgh, Pa.

Duriron Co., Dayton, Ohio

Empire Steel Castings Inc., Reading, Pa.

General Alloys Co., Boston, Mass.

**International Nickel Co., 67 Wall St., New York**

Jessop Steel Co., Washington, Pa.

Latrobe Electric Steel Co., Latrobe, Pa.

**Lebanon Steel Foundry Co., Lebanon, Pa.**

Ludlum Steel Co., Watervliet, N. Y.

Meehanite Metals Corp., Pittsburgh, Pa.

Michigan Steel Casting Co., Detroit, Mich.

Midvale Co., Philadelphia, Pa.

Otis Elevator Co., Buffalo, N. Y.

Pacific Foundry Co., San Francisco, Calif.

Republican Steel Co., Massillon, Ohio

Sessions Foundry Co., Bristol, Conn.

Taylor Wharton Iron & Steel Co., High Bridge, N. J.

Universal-Cyclops Steel Co., Bridgeville, Pa.

Wilson Foundry & Machine Co., Pontiac, Mich.

Youngstown Foundry & Machine Co., Youngstown, Ohio

### CASTINGS, IRON, MALLEABLE

Allied Steel Castings Co., 1225 W. 120th, Chicago

American Radiator Co., Malleable & Steel Plant, 1803 Elmwood Ave., Buffalo, N. Y.

Badger Malleable & Mfg. Co., South Milwaukee, Wis.

Belcher Malleable Iron Co., Easton, Mass.

Benton Harbor Malleable Industries, Benton Harbor, Mich.

Berger Brothers Co., 229 Arch, Philadelphia, Pa.

Carbon Malleable Casting Co., Lancaster, Pa.

Chain Belt Co., 1600 W. Bruce, Milwaukee, Wis.

Chicago Malleable Castings Co., 1225 W. 120th, Chicago

Dalton Foundries, Inc., Warsaw, Ind.

Eastern Malleable Iron Co., Naugatuck, Conn.

Eastern Malleable Iron Co., Wilmington, Del.

Erie Malleable Iron Co., Erie, Pa.

Frazer & Jones Co., 3000 Milton Ave., Solvay, N. Y.

Grabler Mfg. Co., 6565 Broadway, Cleveland, Ohio

Gunite Foundries Corp., 302 Peoples Ave., Rockford, Ill.

Illinois Malleable Iron Co., 1801-25 Diversey Parkway, Chicago

Jeffrey Mfg. Co., Columbus, Ohio

Kennedy Fdry. Co., Baltimore, Md.

Laconia Malleable Iron Co., Inc., Laconia, N. H.

Lakeside Malleable Castings Co., Racine, Wis.

Lockport Fittings Co., Inc., Lockport, N. Y.

Marion Malleable Iron Works, Marion, Ind.

Milwaukee Malleable & Grey Iron Works, Milwaukee, Wis.

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland, Ohio

National Malleable & Steel Castings Co., Cicero, Ill.

Poor & Co., Vermilion Malleable Iron Works, Hoopeston, Ill.

Rhode Island Malleable Iron Works, Hillsgrove, R. I.

Simplex, Inc., Beaver Dam, Wis.

Superior Steel & Malleable Castings Co., Benton Harbor, Mich.

Voorheesville Castings Co., Inc., Voorheesville, N. Y.

### CASTINGS, MAGNESIUM ALLOY

**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**

American Magnesium Corp., 2210 Harvard Ave., Cleveland, Ohio

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.

Dollin Corp., 606 S. 21st, Irvington, N. J.

**Dow Chemical Co., Midland, Mich.**

Doehler Die-Casting Co., Toledo, Ohio

Enterprise Fdry. Corp., 710 Division, San Francisco, Cal.

Hoover Co., The, Maple St., North Canton, Ohio

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland, Ohio

United Metals, 620 Hamilton, Spokane, Wash.

### CASTINGS, MAGNET

Bisset Steel Co., Cleveland, Ohio

Cinaudagraph Corp., Stamford, Conn.

Commercial Steel Casting Co., Marion, Ohio

Crucible Steel Co. of America, 405 Lexington Ave., New York

Rochester Mfg. Co., Rochester, N. Y.

Simonds Saw & Steel Co., Lockport, N. Y.

Sivyer Steel Casting Co., 1675 S. 43rd, Milwaukee, Wis.

***For further information on companies listed***

Taylor-Wharton Iron & Steel Co., Easton, Pa.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

**CASTINGS, STEEL, ALLOY**
*S. A. E. Alloys, also Special Alloys for High Temperatures and Corrosion Resistance*

Babcock & Wilcox Co., Cedar St., New York
Bethlehem Steel Co., Bethlehem, Pa.
Calorizing Co., Pittsburgh, Pa.
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
Chicago Steel Foundry Co., Kedzie Ave. at 37th Pl., Chicago
Cooper Alloy Foundry Co., Elizabeth, N. J.
Detroit Steel Castings Co., Detroit, Mich.
Driver-Harris Co., Harrison, N. J.
Hartford, Conn.
General Alloys Co., 401 First St., Boston
Hartford Electric Steel Corp., Hartford, Conn.
Hubbard Steel Foundry Co., E. Chicago, Ind.
**Lebanon Steel Foundry Co., Lebanon, Pa.**
Michigan Steel Casting Co., Detroit, Mich.
Midvale Co., Nicetown, Philadelphia, Pa.
Ohio Steel Foundry, Springfield, Ohio
Republic Steel Corp., Cleveland, Ohio
Sivyer Steel Castings Co., Milwaukee, Wis.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Treadwell Engineering Co., Easton, Pa.
Warman Steel Casting Co., Huntington Park, Calif.

**CASTINGS, STEEL CARBON**

Allegheny Steel Co., Brackenridge, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
Chicago Steel Foundry Co., Kedzie Ave. at 37th Pl., Chicago
Detroit Steel Casting Co., Detroit, Mich.
Farrell-Cheek Steel Co., Sandusky, Ohio
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Hartford Electric Steel Corp., Hartford, Conn.
Hubbard Steel Foundry Co., East Chicago, Ind.
**Lebanon Steel Foundry Co., Lebanon, Pa.**
Mesta Machine Co., Pittsburgh, Pa.
Michigan Steel Casting Co., Detroit, Mich.
Ohio Steel Foundry, Springfield, Ohio
Sivyer Steel Castings Co., Milwaukee, Wis.
Superior Steel & Malleable Casting Co., Benton Harbor, Mich.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Union Steel Castings Co., Pittsburgh, Pa.
West Michigan Steel Foundry, Muskegon, Mich.

**CHAIN, BEAD**

**Bead Chain Mfg. Co., Bridgeport, Conn.**

**CHAIN, FORGED STEEL LINKS**

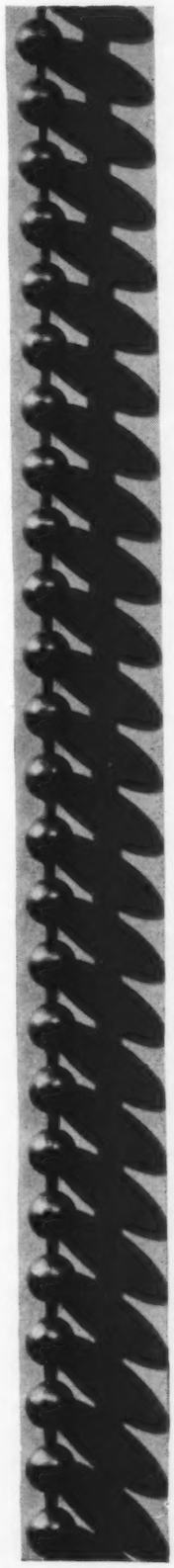
**American Chain Co., Bridgeport, Conn.**
Brewer-Titchener Corp., 111 Port Watson, Cortland, N. Y.
Clapp, E. D., Mfg. Co., Auburn, Ill.
Chain Belt Co., 1600 W. Bruce, Milwaukee. Wis.
Endicott Forging & Mfg. Co., Inc., Endicott, N. Y.
Jeffrey Mfg. Co., Columbus, Ohio
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
McKay Co., 1005 Liberty Ave., Pittsburgh, Pa.
Palmer-Bee Co., Detroit, Mich.
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
**Transue & Williams Steel Forging Corp., Alliance, Ohio**

**CHAIN AND SPROCKETS, BLOCK TYPE**
*For power transmission purposes*

Badger Malleable & Mfg. Co., South Milwaukee, Wis.
Baldwin Duckworth Chain Corp., 369 Plainfield, Springfield, Mass.
**Boston Gear Works, Inc., North Quincy, Mass.**
Chain Belt Co., 1600 W. Bruce, Milwaukee, Wis.
**Cullman Wheel Co., 1344 Altgeld St., Chicago**
**Diamond Chain & Mfg. Co., 443 Kentucky Ave., Indianapolis, Ind.**
Grant Gear Works, Second & B Sts., Boston, Mass.
Jeffrey Mfg. Co., Columbus, Ohio
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass.
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**
Palmer-Bee Co., Detroit, Mich.

*in bold face type, see index on last page*

# INGENUITY



BEAD CHAIN

Trade Mark Reg. U. S. Pat Off.

**BEAD CHAIN* is a series of metal beads, so connected as to produce a combination of perfect swivels, tangle free and unkinkable.**

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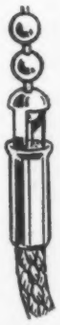
## *Your Ingenuity and Ours*

**Business successes frequently result from an ingenious use of existing items. BEAD CHAIN* is a product that has succeeded through ingenuity — that of manufacturers who have known it, and our own.**

•

## *We Attached Chain to Cord*



**For example, with Venetian Blinds. BEAD CHAIN* was desirable to prevent "slippage" of the tilting device control. The problem was to connect BEAD CHAIN* with the cord used to operate the control wheel. In cooperation with Venetian Blind hardware manufacturers we have developed an ingenious chain and cord connector, together with special pulleys to insure smooth and positive operation of Venetian Blind controls.**

•

**As a manufacturer you very likely have a product problem that BEAD CHAIN* may help solve. Our engineering and design service is prepared to cooperate with you.**

**THE BEAD CHAIN MANUFACTURING CO.**
**62 Mt. Grove St. Bridgeport, Conn.**

***Trade Mark Reg. U. S. Pat. Off.**

### CHAIN & SPROCKETS BLOCK TYPE

*For power transmission purposes (Cont.)*

Philadelphia Gear, Philadelphia, Pa.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Smith, Winfield H., Inc., Springville, Erie Co., N. Y.

Sumner Iron Wks., Everett, Wash.

Union Gear & Machine Co., 27 Purchase, Boston, Mass.

**Whitney Chain & Mfg. Co., 237 Hamilton, Hartford. Conn.**

### CHAIN AND SPROCKETS FOR CONVEYORS MALLEABLE IRON

Badger Malleable & Mfg. Co., South Milwaukee, Wis.

Chain Belt Co., 600 W. Bruce, Milwaukee, Wis.

Illinois Malleable Iron Co., 1801-25 Diversey Parkway, Chicago

Jeffrey Mfg. Co., Columbus, Ohio

**Link-Belt Co., 307 N. Michigan Ave., Chicago**

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland, Ohio

Palmer-Bee Co., Detroit, Mich.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sumner Iron Wks., Everett, Wash.

Union Gear & Machine Co., 27 Purchase, Boston, Mass.

Voorheesville Castings Co., Inc., Voorheesville, N. Y.

Western Gear Works, Seattle, Wash. (sprockets)

Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.

### CHAIN AND SPROCKETS FOR CONVEYORS STEEL

American Manganese Steel Div., American Brake Shoe & Foundry Co., 389 E. 14th, Chicago Heights, Ill.

Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y.

Badger Malleable & Mfg. Co., South Milwaukee, Wis.

Baldwin-Duckworth Chain Corp., 369 Plainfield, Springfield, Mass.

**Boston Gear Works, Inc., North Quincy, Mass.**

Chain Belt Co., 1600 W. Bruce, Milwaukee, Wis.

Crucible Steel Casting Co., Lansdowne, Pa.

**Diamond Chain & Mfg. Co., 1443 Kentucky Ave., Indianapolis, Ind.**

Farrell-Cheek Steel Co., Sandusky, Ohio

Frog Switch & Mfg. Co., Carlisle, Pa.

Ingram-Richardson Mfg. Co., Beaver Falls, Pa.

Jeffrey Mfg. Co., Columbus, Ohio

**Link-Belt Co., 307 N. Michigan Ave., Chicago.**

Medart Co., The, 3500 DeKalb, St. Louis, Mo.

Morse Chain Co., Ithaca, N. Y.

National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland, Ohio

Palmer-Bee Co., Detroit, Mich.

Rogers Iron Works Co., Joplin, Mo.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sumner Iron Wks., Everett, Wash.

Taylor-Wharton Iron & Steel Co., Easton, Pa.

**Transue & Williams Steel Forging Corp., Alliance, Ohio**

Union Gear & Machine Co., 27 Purchase, Boston, Mass.

Western Gear Works, Seattle, Wash. (sprockets)

**Whitney Chain & Mfg. Co.. 237 Hamilton, Hartford. Conn.**

Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.

Whartnaby Gear & Machine Co., Inc., 925 W. Schiller, Philadelphia, Pa.

### CHAIN AND SPROCKETS, ROLLER TYPE

*For power transmission purposes*

Baldwin-Duckworth Chain Corp., 369 Plainfield, Springfield, Mass.

**Boston Gear Works, Inc., North Quincy, Mass.**

Chain Belt Co., 1600 W. Bruce, Milwaukee. Wis.

**Cullman Wheel Co., 1344 Altgeld, Chicago**

**Diamond Chain & Mfg. Co., 443 Kentucky Ave., Indianapolis, Ind.**

Jeffrey Mfg. Co., Columbus, Ohio

Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.

**Link-Belt Co., Indianapolis, Ind.**

Medart Co., The 3500 DeKalb, St. Louis, Mo.

Morse Chain Co., Ithaca, N. Y.

**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**

Palmer-Bee Co., Detroit, Mich.

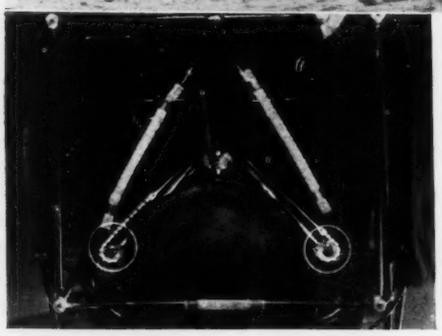
Philadelphia Gear Wks., Philadelphia, Pa.

Smith, Winfield H., Inc., Springville, Erie Co., N. Y.

Sumner Iron Wks., Everett, Wash.

Western Gear Works, Seattle, Wash. (sprockets)

***For further information on companies listed***



# CULLMAN *Sprockets*

**STANDARD EQUIPMENT ON THIS TAYLOR-YOUNG AIRPLANE**

★ Cullman Sprockets known for their accuracy and durability are operating on vital parts of this up-to-date plane.

Cullman Specializes in Sprockets for ALL kinds of chains. Over *45,000* Sprockets in stock.

*Write for Catalog!*

***Address***

**CULLMAN WHEEL CO.**

**1350 ALTGELD ST., CHICAGO, ILL.**

Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Whartnaby Gear & Machine Co., Inc., 925 W. Schiller, Philadelphia, Pa.
**Whitney Chain & Mrg. Co., 237 Hamilton, Hartford, Conn.**

### CHAIN AND SPROCKETS, SILENT TYPE
*For power transmission purposes*

Baldwin-Duckworth Chain Corp., 369 Plainfield, Springfield, Mass.
**Boston Gear Works, Inc., North Quincy, Mass.**
**Cullman Wheel Co., 1344 Altgeld, Chicago**
Grant Gear Works, Second & B Sts., Boston, Mass.
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
**Link-Belt Co., Indianapolis, Ind.**
Morse Chain Co., Ithaca, N. Y.
**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**
Ramsey Chain Co., Inc., Albany, N. Y.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio (sprockets)
Sumner Iron Wks., Everett, Wash.
Western Gear Works, Seattle, Wash. (sprockets)
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Whartnaby Gear & Machine Co., Inc., 925 W. Schiller, Philadelphia, Pa.
**Whitney Chain & Mrg. Co., 237 Hamilton, Hartford, Conn.**

### CIRCUIT BREAKERS
*(see Breakers, Circuit)*

### CLOTH, WIRE WOVEN
*(see Wire Cloth, Woven)*

### CLUTCHES, FRICTION
*Band and Ring types*

Brown Engineering Co., 123 N. Third, Reading, Pa.
Dodge Mfg. Corp., Mishawaka, Ind.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
Hunter, James, Machine Co., North Adams, Mass.
Johnson, Carlyle Machine Co., Manchester, Conn.
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Wood's, T. B., Sons Co., Chambersburg, Pa.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.

### CLUTCHES, FRICTION
*Disk types*

Atkins & Co., E. C., 402 S. Illinois, Indianapolis, Ind.
Third, Reading, Pa.
Brown Engineering So., 123 No.
Dodge Mfg. Corp., Misawauka, Ind.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
**Hilliard Corp., 102 W. 4th, Elmira, N. Y.**
Hunter, James, Machine Co., North Adams, Mass.
Kinney Mfg. Co., 3529 Washington, Boston, Mass.
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Morse Chain Co., Ithaca, N. Y.
Pusey & Jones Corp., Wilmington, Del.
Rockford Drilling Machine Div., Borg-Warner Corp., Rockford, Ill.
Twin Disc Clutch Co., Racine, Wis.
Wood's, T. B., Sons Co., Chambersburg, Pa.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.

### CLUTCHES, MAGNETIC
*For magnetic brakes—see Brakes, Magnetic*

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Dings Magnetic Separator Co., Milwaukee, Wis.
Stearns Magnetic Mfg. Co., 631 S. 28th, Milwaukee, Wis.

### CLUTCHES, OVERRUNNING
*One-directional clutch used to couple two prime movers to a common load, or as a ratchet, a backstop or for backlash*

Columbia Industrial Machinery Co., 4020 W. Lake, Chicago
**Hilliard Corp., 102 W. 4th, Elmira, N. Y.**
Kinney Mfg. Co., 3529 Washington, Boston, Mass.
Moore-Master Mfg. Co., 3450 N. Western Ave., Chicago
Morse Chain Co., Ithaca, N. Y.
Universal Gear Corp., 327 S. LaSalle, Chicago

### COLUMBIUM
Electro Metallurgical Co., 30 E. 42nd, New York
Fansteel Metallurgical Corp., North Chicago, Ill.

### CONNECTORS, WIRE
Crouse Hinds Co., Syracuse, N. Y.
**Cuyahoga Spring Co., 10266 Berea Rd., Cleveland, Ohio**

*in bold face type, see index on last page*


A NEW PRODUCT!

ANACONDA ELECTRO-DEPOSITED

Pure Copper Sheets

Stock widths 30" or 60"...and in rolls of long lengths. Thicknesses—1 ounce per square foot to 5 ounces per square foot (approximately .0015 inches to .007 inches).

NON-POROUS . . . RUST-PROOF

Practical uses for Anaconda "Electro-Sheet" Copper in new fields are innumerable.

*Samples upon request*

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ANACONDA
from mine to consumer

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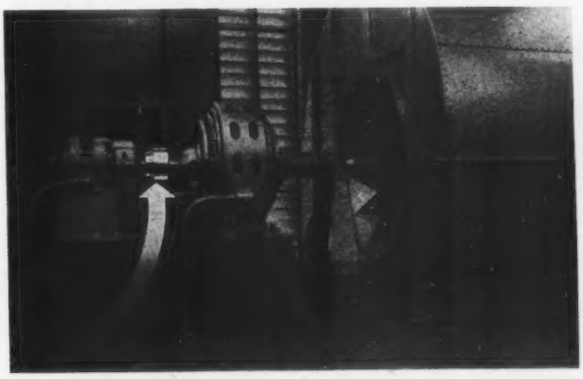
*For the*

LINCOLN TUNNEL

The Port of New York Authority Selected

HILLIARD OVER-RUNNING CLUTCHES

To Drive 14 Ventilating Fans at 2 Speeds



A great tribute has been paid to the Accuracy and Dependability of Hilliard Over-Running Clutches by their selection for this vital work. Hundreds are being used on equally exacting jobs. They will serve you well. For AUTOMATIC Two-Speed or Stand-by Drives. Also as Rachets or Back-stops.

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101 W. Fourth St.
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*It can be Done Better by You*

A registering instrument or counter is necessary to the efficient operation of many production machines. The trend is away from leaving it to the user to hang on motors, control, lighting, counters — and toward building them into the machine — making a real job of it.

*Productimeters* are made by the largest exclusive counting machine manufacturer in the U. S. They are built to last as long as the machine and require minimum attention. "Equipped with *Productimeters*" is one more good sales point for your machines.

**Productimeters** THE SPEEDOMETERS OF INDUSTRY **DURANT MFG. CO.**
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CALLITE
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ENDURANCE
and
DEPENDABILITY

*Made to your Specifications*

- Tungsten and Molybdenum Contacts
- Precious Metal Contacts

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EISLER ELECTRIC CORPORATION
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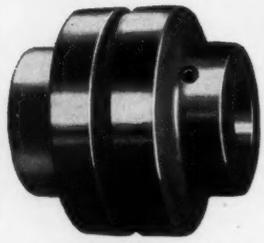
**INVESTIGATE!**



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***before you specify***

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**CONGRESS TOOL & DIE CO.**
**9020 Lumpkin Ave. Detroit, Mich.**


**CONNECTORS, WIRE (Cont.)**
General Electric Co., Bridgeport, Conn.
Gregory Mfg. Co., Mt. Carmel, Conn. (solder lugs)
Ideal Commutator Dresser Co., 1446 Park Ave., Sycamore, Ill.
Kolton Electric Mfg. Co., 123 N.J.R.R. Ave., Newark, N. J.
Metropolitan Elec. Mfg. Co., Long Island City, N Y.
Sherman, H. B., Mfg. Co., 22 Barney, Battle Creek, Mich.
Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

**CONTACTS, ELECTRICAL**
*For electrical controlling and ignition circuits.*
American Platinum Works, Newark, N. J.
Baker & Co., Inc., 113 Astor, Newark, N. J.
**Callite Products Div., Eisler Electric Corp., 558-39th, Union City, N. J.**
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
Fansteel Metallurgical Corp., North Chicago, Ill.
**General Electric Co., Schenectady, N. Y.**
**General Plate Co., Attleboro, Mass.**
General Tungsten Mfg. Co., Inc., 502–23rd, Union City, N. J.
Mallory, P. R., & Co., Inc., 3029 E. Washington Indianapolis, Ind.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
S-M-S Corp., Harper & Rivard Sts., Detroit, Mich.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
**Wilson, H. A., Co., 105 Chestnut, Newark, N. J.**

**CONTROLLERS, AUTOMATIC**
*(see Switches, Pressure and Temperature Control)*

**CONTROL CIRCUITS, AUTOMATIC**
*Design and manufacture of complete automatic control panels incorporating various types and makes of devices.*
General Control Co., Cambridge, Mass.

**CONTROLLERS, DRUM**
*For multi-speed motor control*
Allen-Bradley Co., Milwaukee, Wis.
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Euclid Electric & Mfg. Co., Chardon Rd., Euclid, Ohio
**General Electric Co., Schenectady, N. Y.**
Monitor Controller Co., 51 S. Gay, Baltimore, Md.
Rowan Controller Co., 2313-15 Homewood Ave., Baltimore, Md.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**CONTROLLERS, MAGNETIC**
*(See Motor Starters, Magnetic)*

**CONTROLS, TEMPERATURE**
*(See Thermostats)*

**COPPER, BERYLLIUM**
*Strip form and castings (See also Castings, Beryllium Copper)*
**American Brass Co., Waterbury, Conn.**
**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**
Beryllium Corp. of Pennsylvania, Reading, Pa.
Riverside Metal Co., Riverside, N. J. (strip form)

**COPPER—NICKEL**
*(See under form desired—bars, castings, sheets)*

**COPPER—SILICON**
*(See under form desired—bars, castings, sheets)*

**CORK PRODUCTS**
Armstrong Cork Products Co., Lancaster, Pa.
Auburn Mfg. Co., Middletown, Conn.
Bond Mfg. Corp., Inc., Wilmington, Del.
Chicago Cork Works Co., 2600 N. Crawford Ave., Chicago
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago
Korfund Co., Inc., Long Island City, N. Y.
Liberty Cork Co., Inc., 50 Bostwick Ave., Jersey City, N. J.

**COUNTERS, ELECTRIC**
*For remote registering of production and counting revolutions or strokes*
Automatic Electric Co., W. Van Buren St., Chicago
**Dunn, Struthers, Inc., 146 N. Juniper, Philadelphia, Pa.**
**Durant Mfg. Co., 1938 N. Buffum, Milwaukee, Wis.**
Electronic Products Co., St. Charles, Ill.
Ferranti Elec., Inc., Rockefeller Plaza, New York
**General Electric Co., Schenectady, N. Y.**
**Guardian Electric Mfg. Co., 1621 W. Walnut, Chicago**
Production Instrument Co., 710 W. Jackson Blvd., Chicago
**Veeder-Root, Inc., Hartford, Conn.**
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J. (photoelectric)

***For further information on companies listed***

### COUNTERS, MECHANICAL

*For registering production and counting revolutions or strokes*

Adde & Co., Portland, Me.
**Durant Mfg. Co., 1938 N. Buffum, Milwaukee, Wis.**
Gancher Mfg. Corp., 423 Broome, New York
Hart, R. E., Mfg. Co., Battle Creek, Mich.
Marsh, Jas. P., Corp., 2077 Southport Ave., Chicago
Production Instrument Co., 710 W. Jackson Blvd., Chicago
Redington, F. B., Co., 113 S. Sangamon, Chicago
**Veeder-Root, Inc., Hartford, Conn.**
Waltham Watch Co., Waltham, Mass.

### COUPLINGS, FLEXIBLE

*Wherein the flexible element consists of leather, metal, or fabric disks, keys, gears, chains, rollers, springs, wire cable or rubber.*

Ajax Flexible Coupling Co., Westfield, N. Y.
American Flexible Coupling Co., 1801 Pittsburgh Ave., Erie, Pa.
Baldwin-Duckworth Chain Corp., 369 Plainfield, Springfield, Mass.
Bartlett Hayward Co., Baltimore, Md.
Bond, Charles, Co., Philadelphia, Pa.
Bond Foundry & Machine Co., Manheim, Pa.
**Boston Gear Works, North Quincy, Mass.**
Brown Engineering Co., 123 N. Third, Reading, Pa.
Certified Flexible Coupling, Inc., 122 E. 42nd, New York
Chicago Rawhide Mfg. Co., 1313 Elston Ave., Chicago
**Congress Tool & Die Co., 9020 Lumpkin Ave., Detroit, Mich.**
Continental-Diamond & Fibre Co., Newark, Del.
**Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.**
**Cullman Wheel Co., 1350 Altgeld, Chicago**
**DeLaval Steam Turbine Co., Trenton, N. J.**
**Diamond Chain & Mfg. Co., 443 Kentucky Ave., Indianapolis, Ind.**
Dodge Mfg. Co., Mishwaka, Ind.
Falk Corp., Milwaukee, Wis.
Falls Clutch & Machinery Co., Cuyahoga Falls, Ohio
Farrel-Birmingham Co., Inc., 344 Vulcan, Buffalo, N. Y.
Flexoid Coupling Co., 410 Lakeside Ave., N. W., Cleveland, Ohio
Flex-O-Tube Co., The, 750-14th, Detroit, Mich.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
**Gordon Engineering Co., 3576 Gratiot Ave., Detroit, Mich.**
**Hilliard Corp., Elmira, N. Y.**
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Jeffrey Mfg. Co., Columbus, Ohio
Jones, W. A., Foundry & Machine Co., 4400 W. Roosevelt Road, Chicago
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Lord Mfg. Co., Erie, Pa.
Lovejoy Flexible Coupling Co., 5019 W. Lake, Chicago
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Morse Chain Co., Ithaca, N. Y.
Nicholson, W. H., & Co., 12 Oregon, Wilkes-Barre, Pa.
Northern Pump Co., 920 18th Ave., N. E., Minneapolis, Minn.
Palmer-Bee Co., Detroit, Mich.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio (tube)
**Philadelphia Gear Works, Philadelphia, Pa.**
Ramsey Chain Co., Albany, N. Y.
Royersford Foundry & Machine Co., Royersford, Pa.
Smith Power Transmission Co., Cleveland, Ohio
Smith & Serrell Co., 20 Washington Pl., Newark, N. J.
Smith, T. L., Co., Milwaukee, Wis.
Stewart, F. W., Mfg. Corp., 340 W. Huron, Chicago
Thomas Flexible Coupling Co., Warren, Pa.
Titeflex Metal Hose Co., 500 Frelinghuysen Ave., Newark, N. J.
Waldron, John, Corp., New Brunswick, N. J.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Westinghouse-Nuttall Co., East Pittsburgh, Pa.
Western Gear Works, Seattle, Wash.
**Whitney Chain & Mfg. Co., 237 Hamilton, Hartford, Conn.**
Wood's, T. B., Sons Co., Chambersburg, Pa.

### COUPLINGS, UNIVERSAL JOINT

*Flexible, swivelling metal connection for angular drives.*

**Boston Gear Works, Inc., North Quincy, Mass.**
Dodge Mfg. Co., Mishwaka, Ind.
Dole Valve Co., 1901-41 Carroll Ave., Chicago
Falk Corp., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, Ohio
Mechanics Universal Joint Co., Rockford, Ill.
Medart Co., The, 3500 DeKalb, St. Louis Mo.
Morse Chain Co., Ithaca, N. Y.
National Automatic Tool Co., Richmond, Ind.

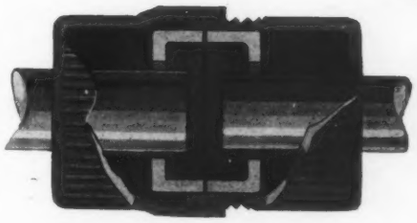
*in bold face type, see index on last page*

*Improve your product with this low-cost*

**NEW FLEXIBLE COUPLING**

Torflex

"THE MISSING LINK"



Left: Phantom view of the Torflex showing how shafts are pressure-bonded to outside cases by rubber bushings (darkest area).

**HOW TORFLEX WORKS**

It transmits power through rubber bushings bonded by pressure to the driving and driven shafts. Tightening of the cases provides pressure. Torflex allows maximum angular and parallel misalignment of shafts. Right or left hand threads, depending upon desired rotation. It will pay you to investigate this new low-cost, trouble-free flexible coupling. Prevents vibration, never whips, runs quietly. Cuts assembly costs by eliminating drilling, tapping, adjusting of screws and other operations. Cushions shocks and protects mechanisms.

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**3576 Gratiot Avenue Detroit, Mich.**

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Company .....

Address .....

## COUPLINGS, UNIVERSAL JOINT

*Flexible, swivelling metal connection for angular drives (Cont.)*

**Philadelphia Gear Works, Philadelphia, Pa.**
Spicer Mfg. Corp., Toledo, Ohio
Universal Products, Inc., Dearborn, Mich.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Western Gear Works, Seattle, Wash.
Wood's, T. B., Sons Co., Chambersburg, Pa.

## CYLINDERS, AIR OPERATED

*For pushing, pulling, feeding, and chucking devices*

Curtis Pneumatic Machinery Co., 1905 Keenlen Ave., St. Louis, Mo.
Denison Engineering Co., 119 W. Chestnut, Columbus, Ohio
Franklin Machine Co., 44 Cross, Providence, R. I.
Hanna Engineering Works, 1773 Elston Ave., Chicago
Hannifin Mfg. Co., 627 S. Kolmar Ave., Chicago
Harrisburg Steel Corp., Harrisburg, Pa.
Logansport Machine Co., Logansport, Ind.
Sumner Iron Wks., Everett, Wash.
Tompkins-Johnson Co., Jackson, Mich.

## CYLINDERS, HYDRAULICALLY OPERATED

*For pushing, pulling, feeding or chucking devices*

Commercial Steel Casting Co., Marion, Ohio
Camden Forge Co., Camden, N. J.
Deming Co., Salem, Ohio
Denison Engineering Co., 119 W. Chestnut, Columbus, Ohio
Franklin Machine Co., 44 Cross, Providence, R. I.
Hanna Engineering Works, 1773 Elston Ave., Chicago
Hannifin Mfg. Co., 627 S. Kolmar Ave., Chicago
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Logansport Machine Co., Logansport, Ind.
Oilgear Co., 1301-1417 W. Bruce, Milwaukee, Wis.
Shenango-Penn Mold Co., Dover, Ohio
Sumner Iron Wks., Everett, Wash.
Tompkins-Johnson Co., Jackson, Mich.
Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

## DECALCOMANIAS

American Decalcomania Co., 4332 5th Ave., Chicago
Chicago Decalcomania Co., 4755 Broadway, Chicago
Consolidated Decalcomania Corp., 2600 Empire State Bldg., New York
Di-Noc Mfg. Co., 1700 London Rd., Cleveland, Ohio
Dura-Products Mfg. Co., Canton, Ohio
International Decalcomania Co., 32 Union Square, New York
Manhattan Decalcomania Co., 402 4th Ave., New York
Meyercord Co., The, 208 W. Washington, Chicago
National Decalcomania Corp., 236 N. 60th, Philadelphia, Pa.
Palm Bros. Decalcomania Co., Cincinnati, Ohio
Rayner-Consolidated Decalcomania Corp., 184-10 Jamaica Ave., Jamaica, N. Y.
Western Lithograph Co., Los Angeles, Calif.

## DIE-CASTINGS

*Zinc and brass*
*(See also Castings, Aluminum Die-Castings)*

Advance Pressure Castings, Inc., 50 N. 15th, Brooklyn, N. Y.
Alemite Die Casting & Mfg. Co., Woodstock, Ill.
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
Apex Smelting Co., 2554 Fillmore, Chicago
Aurora Metal Co., Inc., Aurora, Ill.
Badger Die Casting Co., 1574 S. First, Milwaukee, Wis.
Benton Harbor Malleable Industries, Benton Harbor, Mich.
Cleveland Hardware & Forging Co., 3270 E. 79th, Cleveland, Ohio
**Congress Tool & Die Co., 9020 Lumpkin Ave., Detroit, Mich.**
Continental Die Casting Co., 9615 Grinnell Ave., Detroit, Mich.
Diecasters, Inc., 111 8th Ave., New York
Doehler Die Casting Co., Toledo, Ohio
Dollin Corp., 606 S. 21st, Irvington, N. J.
**Dow Chemical Co., Midland, Mich.**
Federal-Mogul Corp., Detroit, Mich. (tin and lead base only)
Hoover Co., The, Maple St., North Canton, Ohio
Latrobe Die-Casting Corp., Latrobe, Pa.
Malcolm Foundry Co., Inc., 67 Polk, Newark, N. J.
Mt. Vernon Die Casting Corp., Mt. Vernon, N. Y.
New Jersey Zinc Co., 160 Front, New York
New Products Corp., Benton Harbor, Mich. (brass, zinc)
Newton-New Haven Co., 680 Third Ave., West Haven, Conn.
Phoenix Die Casting Co., 21 Illinois, Buffalo, N. Y.
Pressure Castings, Inc., 21500 St. Clair Ave., Cleveland, Ohio
Rupert Diecasting & Stamping Corp., Kansas City, Mo.
Shultz Die Casting Co., Inc., Toledo, Ohio
Stewart Die Casting Corp., 4535 W. Fullerton Ave., Chicago
Titan Metal Mfg. Co., Bellefonte, Pa.
United Metals, 620 Hamilton, Spokane, Wash.
**Veeder-Root, Inc., Hartford Conn.**

## DRIVES, SHORT CENTER

*With pivoted motor base for automatic belt tension.*

Alexander Brothers, 406 N. 3rd, Philadelphia, Pa.
Bonner & Barnewall, Inc., 92 Bleecker, New York
Chicago Belting Co., 117 N. Green, Chicago
Cleveland Electric Motor Co., 5213 Chester, Cleveland, Ohio
Dayton Rubber Mfg. Co., Dayton, Ohio
Dodge Mfg. Corp., Misawauka, Ind.
Foote Gear Works, Cicero, Ill.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Rhoads, J. E., & Sons, 35 N. 6th, Philadelphia, Pa.
Wood's, T. B., Sons Co., Chambersburg, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

## ELECTRONIC DEVICES

*Phototubes and associated devices for automatic control*

**Automatic Electric Co., 1033 W. Van Buren, Chicago.**
Barkelew Electric Mfg. Co., Middletown, Ohio.
Brooke Engr. Co. Inc., 175 W. Huntingdon, Philadelphia, Pa.
Burt, R. C., Scientific Laboratories, Pasadena, Calif.
Clough-Brengle Co., 2815 W. 19th, Chicago.
Electronic Control Corp., 2667 E. Grand Blvd., Detroit, Mich.
Electronic Products Co., St. Charles, Ill.
General Controls Co., 1370 Harrison, San Francisco, Calif.
General Control Corp., Cambridge, Mass.
**General Electric Co., Schenectady, N. Y.**
General Radio Co., 30 State, Cambridge, Mass.
G-M Laboratories, Inc., 1731 Belmont Ave., Chicago.
Link Engineering & Mfg. Co., 1054 W. Baltimore Ave., Detroit, Mich.
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electric Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J.

## ELECTROLYTIC COLOR PLATING

United Chromium, Inc., 51 E. 42nd, New York

## ENAMEL FINISHES

Arco Co., Cleveland, Ohio.
Ault & Wiborg Corp., Cincinnati, Ohio
**Bakelite Corp., 247 Park Ave., New York**
Benjamin Franklin Paint & Varnish Co., 4820 Langdon, Philadelphia, Pa.
Berry Brothers, 211 Leith, Detroit, Mich.
Day, James B., & Co., 1872 Clybourn Ave., Chicago.
**E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Egyptian Lacquer Co., 1270 Sixth Ave., New York.
Fiberloid Corp., Indian Orchard, Mass.
Glidden Co., Cleveland, Ohio.
Hommel O. Co., 209-4th Ave., Pittsburgh, Pa.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Larkin Co., Inc., 1680 Seneca, Buffalo, N. Y.
Lowe Brothers Co., 436 E. 3rd, Dayton, Ohio
Maas & Waldstein, 438 Riverside Ave., Newark, N. J.
Masury, John W. & Son, 50 Jay, Brooklyn, N. Y.
Murphy Varnish Co., 224 McWhorter, Newark, N. J.
National Stamping Co., 630 St. Jean Ave., Detroit, Mich.
Pratt & Lambert, Inc., 73-97 Tonawanda, Buffalo, N. Y.
Roxalin Flexible Lacquer Co., Elizabeth, N. J.
Sherwin Williams Co., Cleveland, Ohio
U. S. Gutta Percha Paint Co., 12 Dudley, Providence, R. I.
Walker, H. V., Co., Elizabeth, N. J.
Whittier, Horace R., Co., Pequabuck, Conn.
Zapon-Brevolite Div., Atlas Powder Co., North Chicago, Ill.
Zapon Div., Atlas Powder Co., Stamford, Conn.

## ENGINES, GASOLINE

*For machine mounting*

**Briggs & Stratton Co., Milwaukee, Wis.**
Buda Co., Harvey, Ill.
Continental Motors Corp., Detroit, Mich.
Fairbanks, Morse & Co., 600 S. Michigan, Chicago
International Harvester Co., 180 N. Michigan, Chicago
Le Roi Co., Milwaukee, Wis.

## ESCUTCHEONS

*(see nameplates)*

## EXPANDED METAL

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.
**Milcor Steel Co., Milwaukee, Wis.**
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago.
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
U. S. Gypsum Co., 300 W. Adams St., Chicago

***For further information on companies listed***

**FELT**
*Sheets, washers, gaskets and shapes*

American Felt Co., 315-4th Ave., New York.
American Hair & Felt Co., Merchandise Mart, Chicago.
Armstrong Cork Products Co., Lancaster, Pa.
Auburn Mfg. Co., Middletown, Conn.
Booth Felt Co., Inc., 424-19th, Brooklyn, N. Y.
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Commonwealth Felt Co., 76 Summer, Boston, Mass.
Continental Felt Co., 880 Broadway, New York.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Excelsior Leather Washer Mfg. Co., Inc., 720 Chestnut, Rockford, Ill.
**Felters Co., Inc., The, 210 South, Boston, Mass.**
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago.
Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
National Motor Bearing Co., Inc., 1100-78th, Oakland, Calif.
Rhodes, James H., & Co., 48-02-29th, Long Island City, N. Y.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago.
Western Felt Works, 4209 Ogden Ave., Chicago.

**FERRULES**
*Brass, copper and steel*

**American Brass Co., Waterbury, Conn.**
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio.
Crosby Co., Buffalo, N. Y.
Grammes, L. F., & Sons, Inc., Allentown, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York.
**Scovill Mfg. Co., Waterbury, Conn.**
Victor Mfg. & Gasket Co., 1059 Menard, Chicago (Brass and Copper)
**Waterbury Button & Mfg. Co., Waterbury, Conn.**
Western Cartridge Co., East Alton, Ill.
Worcester Pressed Steel Co., Worcester, Mass.

**FIBER, VULCANIZED**
*Sheets, rods, tubes, shapes and specialties*

Auburn Mfg. Co., Middletown, Conn.
Brandywine Fibre Products Co., 1402½ Walnut, Wilmington, Del.
Continental-Diamond Fibre Co., Newark, Del.
Franklin Fibre-Lamitex Corp., Wilmington, Del.
**General Electric Co., Schenectady, N. Y.**
National Vulcanized Fibre Co., East Wilmington, Del.
New Process Fibre Co., Greenwood, Del. (sheets, rods).
Spaulding Fibre Co., Inc., 310 Wheeler, Tonawanda, N. Y.
Taylor & Co., Inc., Norristown, Pa.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago.
Wilmington Fibre Specialty Co., New Castle, Del.

**FILTERS, OIL**
*Available for all liquids, also in types continuously cleanable*

Bowen Products Corp., Auburn, N. Y.
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
Cuno Engineering Corp., S. Vine, Meriden, Conn.
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Fauver, J. N., Co., Inc., 91 Sheldon Ave., Detroit, Mich.
Handy Governor Corp., Detroit, Mich.
**Hilliard Corp., Elmira, N. Y.**
Klemm Automotive Products Co., 1718 N. Damen Ave., Chicago.
Kraissl Co., Inc., Hackensack, N. J.
Motor Improvements, Inc., 365 Frelinghuysen Ave., Newark, N. J.
Newark Wire Cloth Co., 351 Verona Ave., Newark, N. J.
Phoenix Wire Wks., 1940 E. Kirby Ave., Detroit
Plouff Co., 1150 Columbus Ave., Boston, Mass.

**FITTINGS**
*For non-ferrous tubing*
(*See tubing, brass and copper*)

Zenith Carburetor Co., 696 Hart Ave., Detroit, Mich.

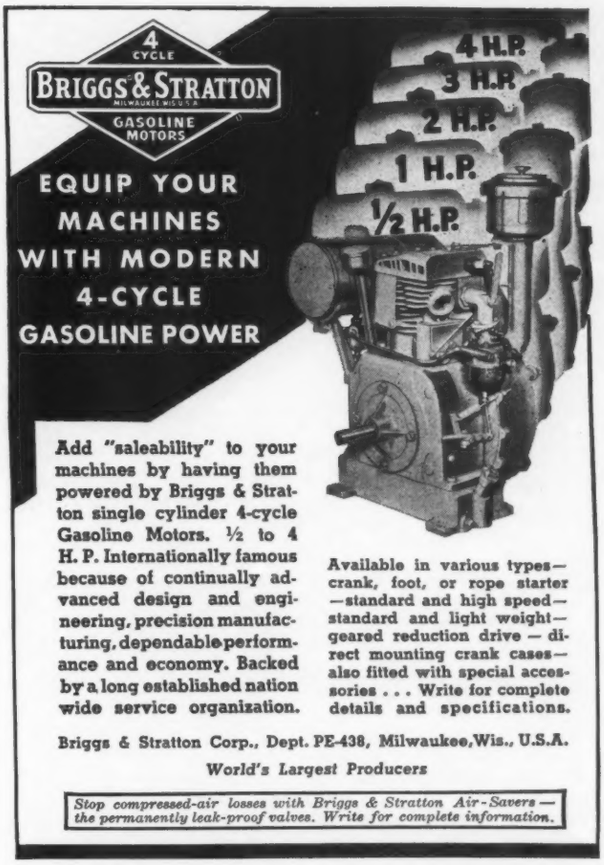
**FORGINGS, BRASS**
(*See also Forgings, Drop*)

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit.
Dole Valve Co., 1901-41 Carroll Ave., Chicago.
Green Bay Foundry & Machine Works, Green Bay, Wis.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York.
Rockwood Sprinkler Co., 38 Hurlow, Worcester, Mass.
**Scovill Mfg. Co., 99 Mill, Waterbury, Conn.**
Titan Metal Mfg. Co., Bellefonte, Pa.
Weatherhead Co., 300 E. 131st, Cleveland, Ohio.
**Williams, J. H. & Co., 400 Vulcan, Buffalo, N. Y.**

**FORGINGS, DROP**
*Steel, aluminum, bronze and other metals*

Akron-Selle Co., Akron, Ohio.

*in bold face type, see index on last page*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GASOLINE MOTORS
EQUIP YOUR MACHINES WITH MODERN 4-CYCLE GASOLINE POWER
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3 H.P.
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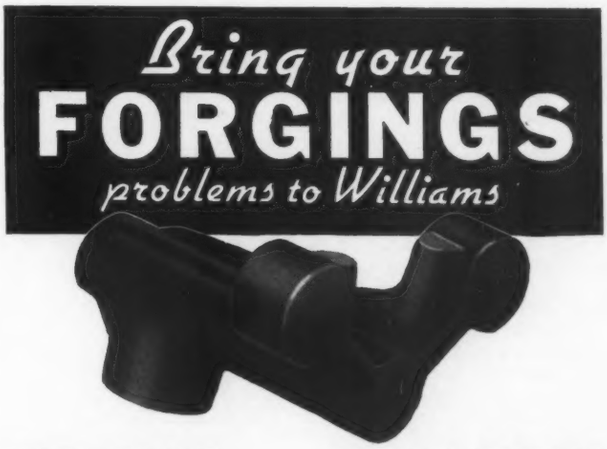
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## FORGINGS, DROP
*Steel, aluminum, bronze and other metals (Cont.)*

Benton Harbor Malleable Industries, Benton Harbor, Mich.
Billings & Spencer Co., 1 Laurel St., Hartford, Conn.
Bonney Forge & Tool Works, Allentown, Pa.
Brewer-Titchener Corp., 111 Port Watson, Cortland, N. Y.
Clapp Mfg. Co., Auburn, N. Y.
Cleveland Hardware & Forging Co., 3270 E. 79th, Cleveland, Ohio.
Endicott Forging & Mfg. Co., Inc., Endicott, N. Y.
Harrisburg Steel Corp., Harrisburg, Pa.
Mitchell Steel Co., Cincinnati, Ohio.
Ohio Forge & Machine Corp., Cleveland, Ohio.
Oliver Iron & Steel Corp., Pittsburgh, Pa
Pettibone Mulliken Corp., 4710 W. Division, Chicago.
Steel Improvement & Forge Co., 960 Addison Rd., Cleveland, Ohio.
**Transue & Williams Steel Forging Corp., Alliance, Ohio**
**Williams & Co., J. H., 400 Vulcan, Buffalo, N. Y.**

## FORGINGS, HAMMERED STEEL

Bethlehem Steel Co., Bethlehem, Pa.
Brewer-Titchener Corp., 111 Port Watson, Cortland, N. Y.
Camden Forge Co., Camden, N. J.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Franklin Machine Co., 44 Cross, Providence, R. I.
Heppenstall Co., 4625 Hatfield, Pittsburgh, Pa.
Johnson, J. R., & Co., Inc., Richmond, Va.
Johnston & Jennnigs Co., 877 Addison Rd., Cleveland, Ohio
Latrobe Electric Steel Co., Latrobe, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Manganese Steel Forge Co., Richmond & Castor Ave., Philadelphia, Pa
Mitchell Steel Co., Stock Yards Sta., Cincinnati, Ohio
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
Oliver Iron & Steel Corp., Pittsburgh, Pa
Pettibone Mulliken Corp., 4710 W. Division, Chicago
Republic Steel Corp., Cleveland, Ohio
Sumner Iron Wks., Everett, Wash.
Taylor-Wharton Iron & Steel Co., Easton, Pa.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Titusville Forge Co., Titusville, Pa.
Transue & Williams Steel Forging Corp., Alliance, Ohio
Universal-Cyclops Steel Corp., Bridgeville, Pa.

## GAGE GLASSES AND FITTINGS

Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Fauver, J. N., Co., Inc., 91 Shelden Ave., Detroit, Mich.
Jenkins Bros., 80 White, New York
Nathan Mfg. Co., 250 Park Ave., New York
Plouff Co., 1150 Columbus Ave., Boston, Mass.

## GAGES, LIQUID LEVEL
*For indicating the level of liquids in tanks*

Bailey Meter Co., Cleveland, Ohio
Bristol Co., Waterbury, Conn.
**Brown Instrument Co., Philadelphia, Pa.**
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Dickson Co., 7420 Woodlawn Ave., Chicago
Foxboro Co., Foxboro, Mass.
Jenkins Bros., 80 White, New York
Johnston & Jennings Co., 877 Addison Rd., Cleveland, Ohio
Kollsman Instrument Co., Inc., 1 Junius, Brooklyn, N. Y.
Liquidometer Corp., 36-16 Skillman Ave., Long Island City, N. Y.
Meriam Co., 1955 W. 112th, Cleveland, Ohio
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
Nathan Mfg. Co., 250 Park Ave., New York
Parks, Harry S., Co., 101 N. 33rd, Philadelphia, Pa.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Pneumercator Co., Inc., 305 E. 46th, New York
Powell, Wm., Co., 2525 Spring Grove Ave., Cincinnati, Ohio
Republic Flow Meters Co., 2240 Diversey Parkway, Chicago
Rochester Mfg. Co., Rochester, N. Y.
Stewart-Warner Corp., 1826 Diversey Parkway, Chicago
Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
U. S. Gauge Co., 44 Beaver, New York

## GAGES, MICROMETER
*Indicator dials used for measurements*

Ames, B. C., Co., Waltham, Mass.
**Brown & Sharpe Mfg. Co., Providence, R. I.**
Federal Products Corp., Providence, R. I.
Haines Gauge Co., Philadelphia, Pa.
Magnetic Gauge Co., Akron, Ohio
Randall & Stickney, Waltham, Mass.
Scherr, George, Co., 128 Lafayette, New York
Starrett, L. S., Co., Athol, Mass.
Testing Machines, Inc., 460 W. 34th, New York
Waltham Dial Gage Co., Waltham, Mass.

## GAGES, PRESSURE
*For indicating pressure in oil, gas, water and steam lines*

Air Reduction Sales Co., 60 E. 42nd, New York
Ashton Valve Co., 161 First, Cambridge, Mass.
Bailey Meter Co., Cleveland, Ohio
Bristol Co., Waterbury, Conn.
**Brown Instrument Co., Philadelphia, Pa.**
Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.
Foxboro Co., Foxboro, Mass.
Kollsman Instrument Co., Inc., 1 Junius, Brooklyn, N. Y.
Linde Air Products Co., 205 E. 42nd, New York
Marsh, Jas. P., Corp., 2073 Southport Ave., Chicago
Mercoid Corp., 4201 Belmont, Chicago
Meriam Co., The, 1955 W. 112th, Cleveland, Ohio
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
National Gauge Corp., 300 Pacific, Brooklyn, N. Y.
Parks, Harry S., Co., 101 N. 33rd, Philadelphia, Pa.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Rochester Mfg. Co., Rochester, N. Y.
Stewart-Warner Corp., 1826 Diversey Parkway, Chicago
Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
U. S. Gauge Co., 44 Beaver, New York
Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

## GASKETS, ASBESTOS
*(See Packings, Asbestos)*

## GASKETS, CORK

Armstrong Cork Products Co., Lancaster, Pa.
Auburn Mfg. Co., Middletown, Conn.
Chicago Cork Works Co., 2600 N. Crawford Ave., Chicago
Chicago-Wilcox Mfg. Co., 7701 Avalon Ave., Chicago
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Excelsior Leather Washer Mfg. Co., Inc., 720 Chestnut, Rockford, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago
Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.
Liberty Cork Co., Inc., 50 Bostwick Ave., Jersey City, N. J.
McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago

## GASKETS, LEATHER

Alexander Brothers, 406 N. 3rd, Philadelphia, Pa.
Auburn Mfg. Co., Middletown, Conn.
Chicago-Wilcox Mfg. Co., 7701 Avalon Ave., Chicago
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Chicago Belting Co., 117 N. Green, Chicago
Excelsior Leather Washer Mfg. Co., Inc., 720 Chestnut, Rockford, Ill.
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago
**Garlock Packing Co., Palmyra, N. Y.**
Goetze Gasket & Packing Co., New Brunswick, N. J.
Houghton, E. F., & Co., 240 W. Somerset, Philadelphia, Pa.
Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
Marsh, Chas. W., Co., Muskegon, Mich.
Rhoads, J. E., & Sons, 35 N. 6th, Philadelphia, Pa.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago
Warren Belting Co., Worcester, Mass.

## GASKETS, METALLIC

Chicago-Wilcox Mfg. Co., 7701 Avalon Ave., Chicago
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
**Crane Packing Co., 1808 Cuyler Ave., Chicago**
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago
**Garlock Packing Co., Palmyra, N. Y.**
Goetze Gasket & Packing Co., New Brunswick, N. J.
Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
Quaker City Rubber Co., Comly & Milnor, Philadelphia, Pa.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
U. S. Indestructible Gasket Co., 829 E. 15th, Brooklyn, N. Y.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago

***For further information on companies listed***

## GASKETS, RUBBER

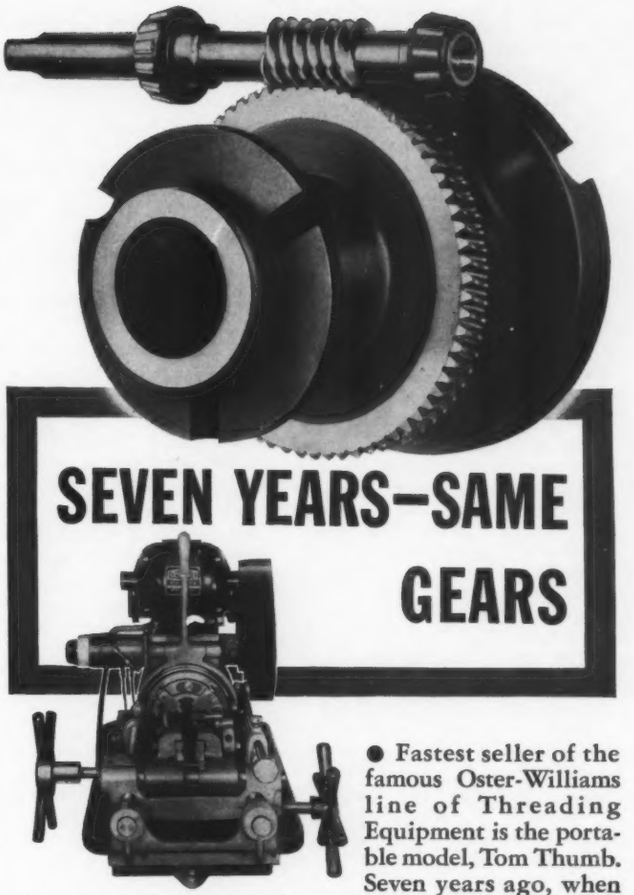
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Chicago-Wilcox Mfg. Co., 7701 Avalon Ave., Chicago
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio
Continental Rubber Works, 1902 Liberty, Erie, Pa.
Corduroy Rubber Co., Grand Rapids, Mich.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Excelsior Leather Washer Mfg. Co., Inc., 720 Chestnut, Rockford, Ill.
Felt Products Mfg. Co., 1504-14 Carroll Ave., Chicago
**Garlock Packing Co., Palmyra, N. Y.**
Gates Rubber Co., 999 S. Broadway, Denver, Colo.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
Goodrich, B. F., Co., 522 S. Main, Akron, Ohio
Goodyear Tire & Rubber Co., E. Market, Akron, Ohio
Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
Manhattan Rubber Mfg. Div., Raybestos - Manhattan, Inc., Passaic, N. J.
Mercer Rubber Co., 136 Mercer, Hamilton Square, N. J.
Quaker City Rubber Co., Comly & Milnor, Philadelphia, Pa.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio
Sponge Rubber Products Co., Derby, Conn. (sponge rubber)
Stokes, Jos., Rubber Co., Trenton, N. J.
**U. S. Rubber Products, Inc., 1790 Broadway, New York**
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago
Western Rubber Co., Goshen, Ind.

## GEARS, BEVEL

*Straight and spiral cut*

Alling-Lander Co., Sodus, N. Y. (straight only)
Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y.
Automotive Gear Works, Inc., Richmond, Ind.
Beaird, J. B., Corp., Shreveport, La.
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
Bond, Charles, Co., Philadelphia, Pa. (straight only)
**Boston Gear Works, Inc., North Quincy, Mass.**
**Brown & Sharpe Mfg. Co., Providence, R. I.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Farrel-Birmingham Co., Buffalo, N. Y.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Franklin Machine Co., 44 Cross, Providence, R. I.
Gears & Forging, Inc., Cleveland, Ohio
**Gear Specialties, Inc., 2690 W. Medill Ave., Chicago**
Gleason Works, 1000 University Ave., Rochester, N. Y.
Hartford Special Machinery Co., Hartford, Conn. (straight only)
Hill Clutch Machine & Foundry Co., Cleveland, Ohio (straight only)
Hoe, R., & Co., Inc., 910 E. 138th, New York (straight only)
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Jeffrey Mfg. Co., Columbus, Ohio
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif. (straight only)
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
**Link-Belt Co., Philadelphia, Pa.**
Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass. (straight only)
Medart Co., The, 3500 DeKalb, St. Louis, Mo. (straight only)
Newark Gear Cutting Co., 69 Prospect, Newark, N. J. (straight only)
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
**Ohio Gear Co., 1325 E. 179th Cleveland, Ohio (straight only)**
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio (straight only)
Stephens-Adamson Mfg. Co., Aurora, Ill. (straight only)
Sumner Iron Wks., Everett, Wash.
Tool Steel Gear & Pinion Co., Cincinnati, Ohio (straight only)
Union Gear & Machine Co., 27 Purchase, Boston, Mass. (straight only)
Universal Gear Corp., Indianapolis, Ind.
Waltham Watch Co., Waltham, Mass. (straight only)
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
West Point Foundry & Machine Co., West Point, Ga. (straight only)

*in bold face type, see index on last page*

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*SAN FRANCISCO, CALIF. Adam-Hill Co., 244-246 Ninth Street.
INDIANAPOLIS, IND. A. R. Young, 518 North Delaware Street.
LOUISVILLE, KY. Alfred Halliday, 330 Starks Building.
DETROIT, MICH. George P. Coulter, 322 Curtiss Building.
MINNEAPOLIS, MINN. W. H. Erskine, Box 72, Traffic Station.
BUFFALO, N. Y. F. E. Allen, Inc., 2665 Main Street.
NEW YORK CITY, N. Y. Patron Millwright & Transmission Co., 154-156 Grand Street.
NEW YORK CITY, N. Y. E. G. Long Co., 50 Church Street.
GRAND RAPIDS, MICH. W. H. Slaughter, 419 Oakdale St., S. E.
NEW ENGLAND. George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
PITTSBURGH, PA. Industrial Sales & Engineering Co., Box 8606, Wilkinsburg, Pa.
SALT LAKE CITY, UTAH. A. O. Gates, 619-629 South Fifth West Street.
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OHIO GEARS

**GEARS, BEVEL**

*Straight and spiral cut (Cont.)*

Western Gear Works, Seattle, Wash.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.
Whartnaby Gear & Machine Co., 925 W. Schiller, Philadelphia, Pa. (straight only)
Worcester Gear Works, Inc., 18 Grafton, Worcester, Mass.

**GEARS, CUT**

**Gear Specialties, Inc., 2690 W. Medill Ave., Chicago**

**GEARS, DIE-CAST**

Advance Pressure Castings, Inc., 47 N. 15th, Brooklyn, N. Y.
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
**Boston Gear Works, North Quincy, Mass.**
Chicago Die-Casting Mfg. Co., 2514 N. Monroe, Chicago
Doehler Die-Casting Co., Toledo, Ohio
Precision Castings Co., Inc., Syracuse, N. Y.

**GEARS, ELLIPTICAL CUT**

Bilgram Gear & Machine Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Farrel-Birmingham Co., Buffalo, N. Y.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Gears & Forgings, Inc., Cleveland, Ohio
Grant Gear Works, Second & B Sts., Boston, Mass.
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
**Link-Belt Co., Indianapolis, Ind.**
Meisel Press Mfg. Co., 944 Dorchester Ave., Boston, Mass.
Perkins Machine & Gear Co., Springfield, Mass.
**Philadelphia Gear Works, Philadelphia, Pa.**
Sumner Iron Wks., Everett, Wash.
Universal Gear Corp., Indianapolis, Ind.
Warner Gear Co., Muncie, Ind.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Western Gear Works, Seattle, Wash.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.

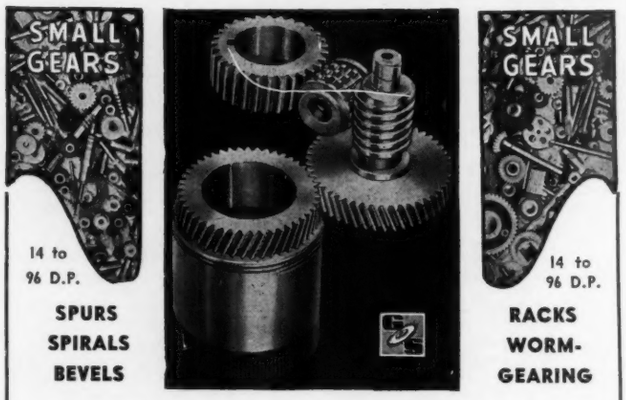
**GEARS, HELICAL CUT**

Alling-Lander Co., Sodus, N. Y.
Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y.
Barber-Colman Co., Rockford, Ill.
Beaird, J. B., Corp., Shreveport, La.
Bond, Charles, Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
**Brown & Sharpe Mfg. Co., Providence, R. I.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
**DeLaval Steam Turbine Co., Trenton, N. J.**
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Falk Corp., Milwaukee, Wis.
Farrel Birmingham Co., 344 Vulcan, Buffalo, N. Y.
Ferguson Gear Co., Gastonia, N. C.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Gilmour, J. M., 151 Lafayette, New York
Gears & Forging, Inc., Cleveland, Ohio
Globe Engineering Co., Philadelphia, Pa.
Grant Gear Works, Second & B Sts., Boston, Mass.
Hartford Special Machinery Co., Hartford, Conn.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
Hoe, R., & Co., Inc., 910 E. 138th, New York
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
**Link-Belt Co., Indianapolis, Ind.**
Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass.
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Morrison Machine Co., 1171-1225 Madison Ave., Paterson, N. J.
Newark Gear Cutting Machine Co., 69 Prospect, Newark, N. J.
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**
Palmer-Bee Co., Detroit, Mich.
Perkins Machine & Gear Co., Springfield, Mass.
**Philadelphia Gear Works, Philadelphia, Pa.**
Smith, Winfield H., Springville, Erie Co., N. Y.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio
Sumner Iron Wks., Everett, Wash.
Tool Steel Gear & Pinion Co., Cincinnati, Ohio
Union Gear & Machine Co., 27 Purchase, Boston, Mass.
Universal Gear Corp., Indianapolis, Ind.
U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles, Calif.
Waltham Watch Co., Waltham, Mass.
Warner Gear Co., Muncie, Ind.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Western Gear Works, Seattle, Wash.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.
Whartnaby Gear & Machine Co., 925 W. Schiller, Philadelphia, Pa.
Worcester Gear Works, Inc., 18 Grafton, Worcester, Mass.

**GEARS, HERRINGBONE CUT**

Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y.
Bilgram Gear & Machine Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
**De Laval Steam Turbine Co., Trenton, N. J.**
Earle Gear & Machine Co., Philadelphia, Pa.
Falk Corp., Milwaukee, Wis.
Farrel Birmingham Co., 344 Vulcan, Buffalo, N. Y.
Ferguson Gear Co., Gastonia, N. C.
Foote Bros., Gear & Machine Corp., 5391 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
**Gear Specialties, Inc., 2690 W. Medill Ave., Chicago**
Gears & Forging, Inc., Cleveland, Ohio
Gilmour, J. M., 151 Lafayette, New York
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Johnson Gear & Mfg. Co., Inc., Berkeley, Calif.
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
**Link-Belt Co., Indianapolis, Ind.**
Newark Gear Cutting Machine Co., 69 Prospect, Newark, N. J.
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
Palmer-Bee Co., Detroit, Mich.


Gear Specialties

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***For further information on companies listed***

Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.
Sumner Iron Wks., Everett, Wash.
Tool Steel Gear & Pinion Co., Cincinnati, Ohio
Universal Gear Corp., Indianapolis, Ind.
Warner Gear Co., Muncie, Ind.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Western Gear Works, Seattle, Wash.

### GEARS, HYPOID CUT

Automotive Gear Works, Inc., Richmond, Ind.
**Boston Gear Works, Inc., North Quincy, Mass.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Gears & Forgings, Inc., Cleveland, Ohio
Gleason Works, 1000 University Ave., Rochester, N. Y.
Grant Gear Works, Second & B Sts., Boston, Mass.
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.
Sumner Iron Wks., Everett, Wash.
Universal Gear Corp., Indianapolis, Ind.
Warner Gear Co., Muncie, Ind.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.

### GEARS, INTERNAL CUT

Automotive Gear Works, Inc., Richmond, Ind.
Beaird, J. B., Corp., Shreveport, La.
Bond, Charles, Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
**Brown & Sharpe Mfg. Co., Providence, R. I.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Earle Gear & Machine Co., Philadelphia, Pa.
Farrel Birmingham Co., 344 Vulcan, Buffalo, N. Y.
Ferguson Gear Co., Gastonia, N. C.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Gears & Forging, Inc., Cleveland, Ohio
Globe Engineering Co., Philadelphia, Pa.
Hartford Special Machinery Co. Hartford, Conn.
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
Lipe, W. C., Inc., Syracuse, N. Y.
Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass.
Medart Co., The, 3500 DeKalb, St. Louis, Mo.
Newark Gear Cutting Machine Co., 69 Prospect, Newark, N. J.
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.
Smith, Winfield H., Springville, Erie Co., N. Y.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio
Steel Products Eng. Co., Springfield, Ohio
Stephens-Adamson Mfg. Co., Aurora, Ill.
Union Gear & Machine Co., 27 Purchase, Boston, Mass.
Universal Gear Corp., Indianapolis, Ind.
Warner Gear Co., Muncie, Ind.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Westinghouse - Nuttall Works, East Pittsburgh, Pa.
West Point Foundry & Machine Co., West Point, Ga.
Whartnaby Gear & Machine Co., 925 W. Schiller, Philadelphia, Pa.
Worcester Gear Works, Inc., 18 Grafton, Worcester, Mass.

### GEARS, SPUR CUT

Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo, N. Y.
American Manganese Steel Div., American Brake Shoe & Foundry Co., 389 E. 14th, Chicago Heights, Ill. (manganese steel)
Automotive Gear Works, Inc., Richmond, Ind.
Barber-Colman Co., Rockford, Ill.
Beaird, J. B., Corp., Shreveport, La.
Bilgram Gear & Mach. Co., Philadelphia, Pa.
Bond, Charles, Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
**Brown & Sharpe Mfg. Co., Providence, R. I.**
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
Dedman Foundry & Machine Co., Houston, Tex.
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Farrel-Birmingham Co., 344 Vulcan, Buffalo, N. Y.
Ferguson Gear Co., Gastonia, N. C.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Franklin Machine Co., 44 Cross, Providence, R. I.
**General Electric Co., Schenectady, N. Y.**
Gilmour, J. M., 151 Lafayette, New York
Globe Engineering Co., Philadelphia, Pa.
Hartford Special Machinery Co., Hartford, Conn.
Hill Clutch Machine & Foundry Co., Cleveland, Ohio
Hoe, R. & Co., Inc., 910 E. 138th, New York
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago
Jeffrey Mfg. Co., Columbus, Ohio
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago
**Link-Belt Co., Indianapolis, Ind.**
Lipe, W. C., Inc., Syracuse, N. Y.
Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass.
Medart Co., The 3500 DeKalb, St. Louis, Mo.
Morrison Machine Co., 1171-1225 Madison Ave., Paterson, N. J.
Newark Gear Cutting Mach. Co., 69 Prospect, Newark, N. J.
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**
Palmer-Bee Co., Detroit, Mich.
Penn Machine Co., 106 Station, Johnstown, Pa.
Perkins Machine & Gear Co., Springfield, Mass.
**Philadelphia Gear Works, Philadelphia, Pa.**
Pusey & Jones Corp., Wilmington, Del.
Smith, Winfield H., Springville, Erie Co., N. Y.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio
Stephens-Adamson Mfg. Co., Aurora, Ill.
Sumner Iron Wks., Everett, Wash.
Tool Steel Gear & Pinion Co., Cincinnati, Ohio
Union Gear & Machine Co., 27 Purchase, Boston, Mass.
Universal Gear Corp., Indianapolis, Ind.
Warner Gear Co., Muncie, Ind.
Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.
Western Gear Works, Seattle, Wash.
Westinghouse Nuttall Works, East Pittsburgh, Pa.
West Point Foundry & Machine Co., West Point, Ga.
Whartnaby Gear & Machine Co., 925 W. Schiller, Philadelphia, Pa.
Worcester Gear Works, Inc., 18 Grafton, Worcester, Mass.

### GEARS, WORMS AND WORMWHEELS, CUT

Alling-Lander Co., Sodus, N. Y.
Atlas Steel Casting Co. 1963 Elmwood Ave., Buffalo, N. Y.
Barber-Colman Co., Rockford, Ill.
Bilgram Gear & Machine Co., Philadelphia, Pa.
Bond, Charles, Co., Philadelphia, Pa.
**Boston Gear Works, Inc., North Quincy, Mass.**
Braun Gear Corp., 1592 Atlantic Ave., Brooklyn, N. Y.
**Brown & Sharpe Mfg. Co., Providence, R. I.**
Cleveland Worm & Gear Co., Cleveland, Ohio
**Cramp Brass & Iron Foundries Co., Philadelphia, Pa.**
**DeLaval Steam Turbine Co., Trenton, N. J.**
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Earle Gear & Machine Co., Philadelphia, Pa.
Ferguson Gear Co., Gastonia, N. C.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.
Franklin Machine Co., 44 Cross, Providence, R. I.
Frog Switch & Mfg. Co., Carlisle, Pa.
Gears & Forging, Inc., Cleveland, Ohio
**Gear Specialties, Inc., 2690 W. Medill Ave., Chicago**
Globe Engineering Co., Philadelphia, Pa.
Hartford Special Machinery Co., Hartford, Conn.

*in bold face type, see index on last page*

**GEARS, WORMS, AND WORMWHEELS, CUT (Con't)**

Hoe, R. & Co., Inc., 910 E. 138th, New York

Indianapolis Gear Works, Indianapolis, Ind.

International Insulating Div., General Industries Co., 500 Winckles, Elyria, Ohio

James, D. O., Mfg. Co., 1114 W. Monroe, Chicago

Jeffrey Mfg. Co., Columbus, Ohio

Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.

Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago

**Link-Belt Co., Indianapolis, Ind.**

Lipe, W. C., Inc., Syracuse, N. Y.

Lumen Bearing Co., 197 Lathrop, Buffalo, N. Y.

Massachusetts Gear & Tool Co., 30 Nashua, Woburn, Mass.

Medart Co., The 3500 DeKalb, St. Louis, Mo.

National Brass Co., 1601 Madison Ave., Grand Rapids, Mich.

Newark Gear Cutting Machine Co., 69 Prospect, Newark, N. J.

Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio

**Ohio Gear Co., 1325 E. 179th, Cleveland, Ohio**

Palmer-Bee Co., Detroit, Mich.

Perkins Machine & Gear Co., Springfield, Mass.

**Philadelphia Gear Works, Philadelphia, Pa.**

Smith, Winfield H., Springville, Erie Co., N. Y.

Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland, Ohio

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sumner Iron Wks., Everett, Wash.

Union Gear & Machine Co., 27 Purchase, Boston, Mass.

Universal Gear Corp, Indianapolis, Ind.

Warner Gear Co., Muncie, Ind.

Watson-Flagg Machine Co., 845 E. 25th, Paterson, N. J.

Western Gear Works, Seattle, Wash.

Westinghouse Nuttall Works, East Pittsburgh, Pa.

West Point Foundry & Machine Co., West Point, Pa.

Whartnaby Gear & Machine Co., 925 W. Schiller, Philadelphia, Pa.

Worcester Gear Works, Inc., 18 Grafton, Worcester, Mass.

**GLASS, FIBROUS**

*Tape, rope, blankets*

Corning Glass Works, Corning, N. Y.

Owens-Illinois Glass Co., Toledo, Ohio

**GLASS, LAMINATED FOR SHIELDS**

Pittsburgh Plate Glass Co., Pittsburgh, Pa.

**GOLD**

*Sheet, wire, tubing*

American Platinum Works, Newark, N. J.

Baker & Co., Inc., 113 Astor, Newark, N. J.

Bishop, J. & Co., Platinum Works, 12 Channing Ave., Malvern, Pa.

**General Plate Co., 40 Forest, Attleboro, Mass.**

Goldsmith Bros., Smelting & Refining Co., 58 E. Washington, Chicago

Handy & Harman, 82 Fulton, New York

White, S. S., Dental Mfg. Co., 10 E. 40th, New York (wire)

Williams Gold Refining Co., Buffalo, N. Y.

**Wilson, H. A., Co., Newark, N. J.**

**GROMMETS, FIBER**

(*See Fiber, Vulcanized*)

**HANGER BOXES, BALL BEARING**

Ahlberg Bearing Co., 321 E. 29th, Chicago

Dodge Mfg. Co., Mishawaka, Ind.

Fafnir Bearing Co., New Britain, Conn.

Hill Clutch Machine & Foundry Co., Cleveland, Ohio

Royersford Foundry & Machine Co., Royersford, Pa.

SKF Industries, Inc., Philadelphia, Pa.

Split Ballbearing Corp., Lebanon, N. H.

Sumner Iron Wks., Everett, Wash.

Wood's, T. B., Sons Co., Chambersburg, Pa.

**HANGER BOXES, ROLLER BEARING**

Bond Foundry & Machine Co., Manheim, Pa.

Dodge Mfg. Co., Mishawaka, Ind.

Hill Clutch Machine & Foundry Co., Cleveland, Ohio

Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago

Medart Co., The, 3500 De Kalb, St. Louis, Mo.

Royersford Foundry & Machine Co., Royersford, Pa.

Shafer Bearing Corp., 650 W. Grand Ave., Chicago

Sumner Iron Wks., Everett, Wash.

Wood's, T. B., Sons Co., Chambersburg, Pa.

**HEATING UNITS**

*Inclosed strip and cartridge type units*

Acme Electric Heating Co., 1217 Washington, Boston, Mass.

Carborundum Co., Niagara Falls, N. Y.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

**General Electric Co., Schenectady, N. Y.**

Jeliff, C. O., Mfg. Co., Southport, Conn.

Linde Air Products Co., 205 E. 42nd, New York

Trent, Harold E., Co., Philadelphia, Pa.

Watlow Electric Mfg. Co., St. Louis, Mo.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Weston Electrical Instrument Corp., Newark, N. J.

**Wiegand, Edwin L., Co., Pittsburgh, Pa.**

**HOSE, FLEXIBLE METAL**

(*See Tubing, Metallic, Flexible*)

**HOSE, NON-METALLIC**

*Rubber and fabric composition flexible hose*

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge, Mass.

Chicago Tubing & Braiding Co., Maywood, Ill.

**Du Pont de Nemours, Inc., Wilmington, Del.**

Electric Hose & Rubber Co., Wilmington, Del.

Flex-O-Tube Co., Detroit, Mich.

Gates Rubber Co., 999 S. Broadway, Denver, Colo.

Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.

Goodrich, B. F., Co., Akron, Ohio

Goodyear Tire & Rubber Co., Akron, Ohio

Hewitt Rubber Corp., Buffalo, N. Y.

Linde Air Products Co., 205 E. 42nd, New York

Manhattan Rubber Mfg. Co., Passaic, N. J.

New York Belting & Packing Co., Passaic, N. J.

Quaker City Rubber Co., Philadelphia, Pa.

Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio

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Chicago, Illinois

**REG. U. S. PAT. OFF. & FOREIGN COUNTRIES*

***For further information on companies listed***

Thermoid Rubber Co., Trenton, N. J.
U. S. Rubber Co., 1790 Broadway, New York
Weatherhead Co., 300 E. 131st, Cleveland, Ohio

**INSULATING MATERIAL, HEAT AND SOUND**
*(see Felt, sheets and rolls; also Cork)*

Armstrong Cork Products Co., Lancaster, Pa.
General Insulating & Mfg. Co., Alexandria, Ind.
Johns-Manville Co., 20 E. 40th St., New York
**Kimberly-Clark Corp., 8 S. Michigan Ave., Chicago**
Ruberoid Co., 500 Fifth Ave., New York
United States Gypsum Co., 300 W. Adams, Chicago
Wood Conversion Co., St. Paul, Minn.

**IRIDIUM**
American Platinum Works, Newark, N. J.
Baker & Co., Inc., 113 Astor, Newark, N. J.
Bishop, J., & Co., 12 Channing Ave., Malvern, Pa.
Goldsmith Bros., Smelting & Refining Co., 58 E. Washington, Chicago

**KEYS, MACHINE**
*Woodruff, spline or feather, square and rectangular types*

Eaton Mfg. Co., Massillon, Ohio
Hoe, R., & Co., Inc., 910 E. 138 St., New York
Hunter Machine Co., North Adams, Mass.
Medart Co., The 3500 De Kalb, St. Louis, Mo.
Moltrup Steel Products Co., Beaver Falls, Pa.
Standard Steel Specialties Co., Beaver Falls, Pa.
**Whitney Chain & Mfg. Co., Hartford, Conn.**

**LACQUER FINISHES**
Apollo Metal Works, 6601 S. Oak Park Ave., Chicago
Arco Co., Cleveland, Ohio
Ault & Wiborg Corp., Cincinnati, Ohio
**Bakelite Corp., 47 Park Ave., New York**
Benjamin Franklin Paint & Varnish Co., 4820 Langdon, Philadelphia, Pa.
Berry Brothers, 211 Leib, Detroit, Mich.
Day, J. B., & Co., 1872 Claybourn Ave., Chicago
**Du Pont de Nemours & Co., Wilmington, Del.**
Egyptian Lacquer Mfg. Co., 1270 Sixth Ave., New York
Fiberloid Corp., Indian Orchard, Mass.
General Plastics, Inc., North Tonawanda, N. Y.
Glidden Co., Cleveland, Ohio
Larkin Co., Inc., 80 Seneca, Buffalo, N. Y.
Lowe Brothers Co., Dayton, Ohio
Maas & Waldstein, 438 Riverside Ave., Newark, N. J.
Masury, John W., & Son, 50 Jay, Brooklyn, N. Y.
Monsanto Chemical Co., Everett Sta., Boston, Mass.
Murphy Varnish Co., 224 McWhorter, Newark, N. J.
Pierce & Stevens, Inc., Buffalo, N. Y.
Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Pratt & Lambert, Inc., Buffalo, N. Y.
Roxalin Flexible Lacquer Co., Elizabeth, N. J.
Sherwin Williams Co., Cleveland, Ohio
Walker, H. V., Co., Elizabeth, N. J.
Zapon-Brevolite Div., Atlas Powder Co., Marquette, N. Chicago
Zapon Div. Atlas Powder Co., Stamford, Conn.

**LAMPS, ELECTRIC**
*Electric lamp bulbs of various shapes and sizes for illumination*

Eagle Electric Mfg. Co., Inc., 59-79 Hall, Brooklyn, N. Y.
**General Electric Lamp Works, Nela Park, Cleveland, Ohio**
Hygrade Sylvania Corp., Salem, Mass.
North American Electric Lamp Co., St. Louis, Mo.
Westinghouse Lamp Works, Bloomfield, N. J.

**LEAD AND LEAD ALLOYS**
Ajax Metal Co., Philadelphia, Pa.
Alpha Metal & Rolling Mills, Inc., Hudson Ave., Brooklyn, N. Y.
American Smelting & Refining Co., Equitable Bldg., New York
Michigan Smelting & Refining Co., Detroit, Mich.
National Lead Co., 111 Broadway, New York
Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.
Goldsmith Bros., Smelting & Refining Co., 58 E. Washington, Chicago
Lumen Bearing Co.. 197 Lathrop St., Buffalo, N. Y.
National Bearing Metals Corp., St. Louis, Mo.
Union Switch & Signal Co., Swissvale, Pa.

**LEATHER PARTS**
*(See Packings, Leather)*

***in bold face type, see index on last page***

"I WANT THE ONE THAT HAS THE CHROMALOX ELECTRIC HEATING UNIT"

Electric heat is a mystery to her—all she knows about it is that Chromalox units hit a new high in speed of heating and in long-lived satisfaction. Over a hundred thousand like her are talking enthusiastically about their Chromalox-equipped electric ranges, other thousands are enjoying the economy and convenience of Chromalox-heated domestic water, still others the comfort of Chromalox-warmed air from space heaters or air heaters. Chromalox has become a "buy-word" for electrically heated domestic appliances. **Why not give your product the sales advantage of Chromalox units?**

INDUSTRIAL HEAT, TOO

Wherever electric heat is used industrially, Chromalox units are preferred equipment. They are largely used in manufactured equipment for process work, in presses, etc. for the fabricating of bakelite and other plastics, in rubber handling equipment, in kettles, ovens, gluing machines, soldering irons, and a great variety of similar uses.

Chromalox units are available in types for heating air, fluids, semi-fluids, machine parts, and anything else industrial, up to 1000 deg. F.

**Have you a specific problem? Why not use the willing cooperation of our engineering staff, specialists in electric heat?**

For immediate information, mail the coupon with your business letterhead for your copy of the 64-page Chromalox Book of Electric Heat.

**EDWIN L. WIEGAND COMPANY** 4
**7535 Thomas Boulevard, Pittsburgh, Pa.**
Send me the CHROMALOX BOOK OF ELECTRIC HEAT.

Name..... Position.....

**LENSES**
*For panels and instruments*
Bache, Semon, & Co., 642 Greenwich, New York
Bausch & Lomb Optical Co., Rochester, N. Y.
Emeloid Co., Inc., Arlington, N. J.
Lancaster Lens Co., Lancaster, Ohio
Matisse Bros., Inc., 789 E. 138 St., New York
Molded Insulation Co., 3246 Ludlow, Philadelphia

**LIGHTING FIXTURES, BUILT-IN**
*For mounting on machines*
Day-Brite Lighting Inc., 5401 Bulwer Ave., St. Louis, Mo.
Fostoria Pressed Steel Co., Fostoria, Ohio
Miller Co., Meriden, Conn.
White, O. C., Mfg. Co., Worcester, Mass.

**LUBRICATING SYSTEMS**
*Automatic Oiling*
Rivett Lathe & Grinder Co., Boston, Mass.
United-American Bosch Co., Springfield. Mass.

**LUBRICATORS, OIL CUPS**
Adams Grease Gun Corp., 54 W. 21st, New York
Allen, W. D., Mfg. Co., 566 W. Lake, Chicago
Bay State Stamping Co., Worcester, Mass.
Bowen Products Corp., Canal St., Auburn, N. Y.
Crane Co., 836 S. Michigan Ave., Chicago
Detroit Lubricator Co., Detroit, Mich.
Fauver, J. N., Co., Inc., 91 Selden Ave., Detroit, Mich.
**Gits Bros. Mfg. Co., 1846 So. Kilbourn Ave., Chicago**
**Hunter Pressed Steel Co., Lansdale, Pa.**
Lunkenheimer Co., Cincinnati, Ohio
Madison-Kipp Corp., Madison, Wis.
McCord Radiator & Mfg. Co., Detroit, Mich.
Nathan Mfg Co., 250 Park Ave., New York
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Powell Co., Cincinnati, Ohio
Rivett Lathe & Grinder, Inc., 20 Riverview Rd., Boston, Mass.
Sherman Mfg Co., Battle Creek, Mich.

**LUBRICATORS, OILERS**
Adams Grease Gun Corp., 54 West 21st, New York
Bowser, S. F., & Co., Fort Wayne, Ind.
Cincinnati Ball Crank Co., Disney St., Cincinnati, Ohio
Crane Co., 836 S. Michigan Ave., Chicago
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Fauver, J. N., Co., Inc., 91 Selden Ave., Detroit, Mich.

GITS Oilers
• Your lubrication problems, whether large or small, will find the correct answer in the Gits Line. If your requirements are of special nature, send us your specifications.
GITS BROS. MFG. CO.
27 years of oil cup experience
1859 S. Kilbourn Ave.
Chicago

**Gits Bros. Mfg. Co., 1846 S. Kilbuorn Ave., Chicago**
**Hunter Pressed Steel Co., Lansdale, Pa.**
Manzel Bros. Co., Buffalo, N. Y.
Nathan Mfg. Co., 250 Park Ave., New York
Nugent & Co., Inc., 410 N. Hermitage Ave., Chicago
Lunkenheimer Co., Cincinnati, Ohio
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Powell Co., Cincinnati, Ohio
Rivett Lathe & Grinder, Inc., 20 Riverview Rd., Boston, Mass.
Sherman, H. B., Mfg. Co., Battle Creek, Mich.
Speedway Mfg. Co., Cicero, Ill.
Victor Lubricating Sales Corp., 4110 N. Damen Ave., Chicago

**LUBRICATORS, GREASE CUPS**
Adams Grease Gun Corp., 54 West 21st, New York
**Alemite Div., Stewart Warner Corp., 1826 Diversey Parkway, Chicago**
Bay State Stamping Co., Worcester, Mass.
Bowen Products Corp., Canal St., Auburn, N. Y.
Crane Co., 836 S. Michigan Ave., Chicago
Detroit Lubricator Co., Detroit, Mich.
**Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago**
**Hunter Pressed Steel Co., Lansdale, Pa.**
Lunkenheimer Co., Cincinnati, Ohio
Madison-Kipp Corp., Madison, Wis.
McCord Radiator & Mfg. Co., Detroit, Mich.
Nathan Mfg. Co., 250 Park Ave., New York
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Powell Co., Cincinnati, Ohio
Sherman Mfg. Co., Battle Creek, Mich.

**LUBRICATORS, GREASE GUN FITTINGS**
Adams Grease Gun Corp., 54 West 21st, New York
**Alemite Div., Stewart Warner Corp., 1826 Diversey Parkway, Chicago**
Bowen Products Corp., Canal St., Auburn, N. Y.
Cincinnati Ball Crank Co., Disney St., Cincinnati, Ohio
Farval Corp., 3252 E. 80 St., Cleveland, Ohio
Fauver, J. N., Co., Inc., 91 Selden Ave., Detroit, Mich.
Lincoln Engineering Co., St. Louis, Mo.

**LUBRICATORS, PUMP TYPE, OIL**
Adams Grease Gun Corp., 54 West 21st, New York
**Alemite Div., Stewart Warner Corp., 1826 Diversey Parkway, Chicago**
Bowen Products Corp., Canal St., Auburn, N. Y.
Bowser, Inc., S. F., & Co., Fort Wayne, Ind.
Cincinnati Ball Crank Co., Disney St., Cincinnati, Ohio
Farval Corp., 3252 E. 80 St., Cleveland, Ohio
Fauver, J. N., Co., Inc., 91 Selden Ave., Detroit, Mich.
McCord Radiator & Mfg. Co., Detroit, Mich.
Manzel Bros. Co., Buffalo, N. Y.
Nathan Mfg. Co., 250 Park Ave., New York
Nichols, W. H., Waltham, Mass.
Nugent & Co., Inc., 410 N. Hermitage Ave., Chicago
Plouff Co., 1150 Columbus Ave., Boston, Mass.
Rivett Lathe & Grinder, Inc., 20 Riverview Rd., Boston, Mass.

**MAGNESIUM ALLOYS**
*Sand and die-castings, sheets, plates, rods, bars, forgings, extruded shapes, hot pressings*
**Aluminum Company of America, 2193 Gulf Bldg., Pittsburgh, Pa.**
American Magnesium Corp., 2210 Harvard Ave., Cleveland, Ohio
Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.
Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.
Doehler Die-Casting Co., Toledo, Ohio
**Dow Chemical Co., Midland, Mich.**

**MAGNETS, ELECTRO**
*Coils and magnets wound to order, see also Relays.*
Cutler-Hammer, Inc., Milwaukee, Wis.
Detroit Coil Co., 4417 Fort, Detroit, Mich.
Dings Magnetic Separator Co., Milwaukee, Wis.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Electrical Coil Winding Co., 2735 Saunders, Camden, N. J.
Ohio Electric Mfg. Co., Cleveland, Ohio
Signal Engineering & Mfg. Co., 156 W. 14th, New York
Stearns Magnetic Mfg. Co., 631 S. 28th, Milwaukee, Wis.

**MAGNET STEEL, SPECIAL ALLOYS**
*For permanent magnets*
Allegheny Steel Co., Brackenridge, Pa.
**Carpenter Steel Co., Reading, Pa.**
Cinaudagraph Corp., Stamford, Conn.
Crucible Steel Co. of America, 405 Lexington, New York
Indiana Steel Products Co., 137 La Salle, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.

***For further information on companies listed***

Ludlum Steel Co., Watervliet, N. Y.
Simonds Saw & Steel Co., Lockport, N. Y.
Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
Universal-Cyclops Steel Corp., Bridgeville, Pa.

**METERS, POWER FACTOR**
**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**
**General Electric Co., Schenectady, N. Y.**
Roller-Smith Co., 233 Broadway, New York
Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York
Weston Electric Instrument Corp., Newark, N. J.

**MICA, PLATES AND TUBES**
American Mica Products Co., 315 W. Chestnut, Chicago
Asheville Mica Co., Biltmore, N. C.
Continental Diamond Fibre Co., Newark, Del.
Farnam & Co., 213 N. Desplaines, Chicago
Industrial Mica Corp., 949-61 St., Brooklyn, N. Y.
Macallen Co., 61 Macallen, Boston, Mass.
Mica Insulator Co., 200 Varick, New York

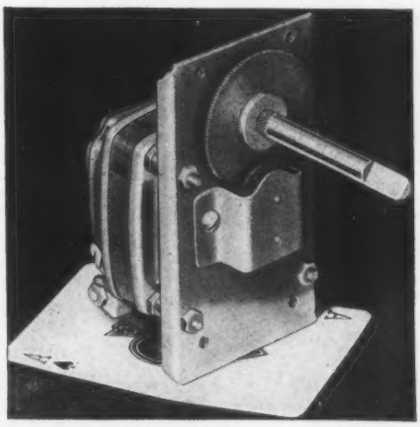
**MOLYBDENUM**
*Wire parts, Rod and Sheets*
Belmont Smelting & Refining Works, 307 Belmont Ave., Brooklyn, N. Y.
**Callite Products Div., 550-39th, Union City, N. J.**
Driver, Wilbur B., Co., 150 Riverside Ave., Newark, N. J.
Fansteel Metallurgical Corp., North Chicago, Ill.
Mallory, P. R., & Co., Indianapolis, Ind.
S-M-S Corp., Harper & Rivard Sts., Detroit, Mich.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, CAPACITOR A.C.**
*All sizes, foot or flange mounting, splash-proof, inclosed or explosion-proof, built-in speed reducer, except where noted otherwise*
**Alliance Mfg. Co., Alliance, Ohio**
Allis, Louis, Co., Milwaukee, Wis.
Baldor Electric Co., St. Louis, Mo.
Bodine Electric Co., 2254, W. Ohio, Chicago (up to 1-3 hp. except explosion-proof)
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Century Electric Co., St. Louis, Mo. (except explosion-proof)
**Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.** (except explosion-proof)
Diehl Mfg. Co., Elizabethport, N. J.
Electric Specialty Co., Stamford, Conn. (except explosion-proof)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago (except inclosed, explosion-proof and built-in speed reducer)
Fidelity Electric Co., Lancaster, Pa. (only up to 1 hp. and open and inclosed foot mounting types)
Forbes & Myers, Worcester, Mass. (except built-in speed reducers)
**General Electric Co., Schenectady, N. Y.**
Holtzer-Cabot Electric Co., 125 Armory, Boston, Mass. (up to 3-4 hp., foot and flange mounting, open and inclosed types only)
Howell Electric Motors Co., Howell, Mich.
Imperial Electric Co., Akron, Ohio
Janette Mfg. Co., 556 W. Monroe, Chicago (up to 1-4 hp. only)
Kingston-Conley Electric Co., 68 Brook Ave., N. Plainfield, N. J. (except built-in speed reducer)
Leland Electric Co., Dayton, Ohio
Marble-Card Electric Co., Gladstone, Mich. (except explosion-proof)
Master Electric Co., Dayton, Ohio
Ohio Electric Mfg. Co., 5911 Maurice Ave., Cleveland, Ohio
**Peerless Electric Co., Warren, Ohio** (up to 1-2 hp., foot and flange mounting, open and inclosed types)
Reynolds Electric Co., 2650 W. Congress, Chicago
Robbins & Myers, Inc., Springfield, Ohio
Russell Electric Co., 340 W. Huron, Chicago
Sturtevant, B. F., Co., Hyde Park, Mass. (open type, foot mounting only)
Wagner Electric Corp., St. Louis, Mo. (except explosion proof and built-in speed reducer)
Wesche, B. A., Electric Co., Cincinnati, Ohio (except explosion-proof and built-in speed reducer)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, MIDGET SIZES**
**Alliance Mfg. Co., Alliance, Ohio**
Barber-Colman Co., Rockford, Ill.
Bodine Electric Co., 2254 W. Ohio, Chicago
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Chicago Electric Mfg. Co., 6333 W. 65th, Chicago
**Delco Appliance Div., General Motors Sales Corp., 391 Lyell Ave., Rochester, N. Y.**
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor St., Elyria, Ohio**
Reynolds Electric Co., 2650 W. Congress, Chicago
Russell Electric Co., 340 W. Huron, Chicago
Signal Electric Mfg. Co., Menominee, Mich.
Smith, F. A., Mfg. Co., Inc., Rochester, N. Y.
Speedway Mfg. Co., Cicero, Ill.

**MOTORS, REPULSION, A.C.**
*Obtainable in all sizes, foot or flanged mounted, splash-proof, inclosed or explosion proof, and with built-in speed reducers, except where noted otherwise.*
Advance Electric Co., St. Louis, Mo. (open frame and foot mounting only)
**Alliance Mfg. Co., Alliance, Ohio**
Baldor Electric Co., St. Louis, Mo. (fractional hp. only, except explosion proof and built-in speed reducer)
Bodine Electric Co., 2254 W. Ohio, Chicago (except inclosed and explosion proof)
Brown-Brockmeyer Co., Dayton, Ohio
Burke Electric Co., Erie, Pa. (except built-in speed reducer)
Century Electric Co., St. Louis, Mo. (except explosion-proof)
Continental Electric Co., Inc., 325 Ferry, Newark, N. J. (except explosion-proof)
**Delco Appliance Div., General Motors Sales Corp., 391 Lyell Ave., Rochester, N. Y.**
Diehl Mfg. Co., Elizabethport, N. J. (except built-in speed reducer)
Electric Specialty Co., Stamford, Conn. (except explosion-proof)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago (except inclosed explosion-proof and built-in speed reducer)
Fidelity Electric Co., Lancaster, Pa. (except flange mounting, explosion-proof and built-in speed reducer)
**General Electric Co., Schenectady, N. Y.**
Holtzer-Cabot Electric Co., 125 Armory, Boston, Mass. (except explosion-proof and built-in speed reducer)
Howell Electric Motors Co., Howell, Mich. (except explosion-proof)
Janette Mfg. Co., 556 W. Monroe, Chicago (up to 1-2 hp. only)
Kimble Electric Co., 2011 Hastings, Chicago (except flange mounting, explosion proof, and built-in speed reducer)
Leland Electric Co., Dayton, O.
Master Electric Co., Dayton, O.

*in bold face type, see index on last page*

*The* ACE OF MINIATURE MOTORS

THE new Alliance Model "R" motor combines greater speed and power with exclusive safety and dependability features to make it the most rugged and efficient motor of its kind. Securely mounted, self-aligning, oilless bearings guarantee permanent shaft alignment and noiseless operation. Thermostatic protection against accidental burning out, plus ample heat radiating area provided by the housing, make the Model "R" ideal for concealed positions. Yet the overall dimensions are only 2¼" x 2¼" x 1⅝" (without gear assembly). The Alliance Model "R" motor can be had now in large quantities at low cost. Mounting and gear assemblies will be supplied to meet your particular demands and specifications.

*Write, Wire or Phone for Complete Details and Sample.*

**ALLIANCE MFG. CO., Alliance, Ohio**

**MOTORS, REPULSION, A.C.**
*Obtainable in all sizes, foot or flanged mounted, splash-proof, inclosed or explosion proof, and with built-in speed reducers, except where noted. (Continued)*

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. (fractional hp. only)
**Peerless Electric Co., Warren, Ohio** (except explosion proof and built-in speed reducer)
Robbins & Myers, Inc., Springfield, Ohio
Star Electric Motor Co., Bloomfield, N. J.
Valley Electric Corp., St. Louis, Mo. (except built-in speed reducer)
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, A.C., SHADED POLE**
*Obtainable in small fractional hp. with built-in speed reducer*

**Alliance Mfg. Co., Alliance, Ohio**
Baldor Electric Co., St. Louis, Mo.
Barber-Colman Co., Rockford, Ill.
Black & Decker Electric Co., Kent, Ohio
Bodine Electric Co., 2254 W. Ohio, Chicago
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Century Electric Co., 1806 Pine St., St. Louis, Mo.
Chicago Electric Mfg. Co., 6333 W. 65th, Chicago
**Delco Appliance Corp., Rochester, N. Y.** (except built-in speed reducer)
Diehl Mfg. Co., Elizabethport, N. J. (except built-in speed reducer)
Electric Motor Corp., Racine, Wis.
Emerson Electric Mfg. Co., St. Louis, Mo.
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor St., Elyria, Ohio**
Gilbert, A. C., Co., New Haven, Conn.
Hansen Mfg. Co., Princeton, Ind.
Heinze Electric Co., Lowell, Mass. (except built-in speed reducer)
Kendrick & Davis Co., Lebanon, N. H.
Leland Electric Co., Dayton, O.
Master Electric Co., Dayton, O.
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
Ohio Electric Mfg. Co., Cleveland, Ohio (except built-in speed reducer)
**Peerless Electric Co., Warren, Ohio**
Reynolds Electric Co., 2650 W. Congress, Chicago
Robbins & Myers, Inc., Springfield, Ohio
Russell Electric Co., 340 W. Huron, Chicago
Signal Electric Mfg. Co., Menominee, Mich.
Smith, F. A., Mfg. Co., Rochester, N. Y. (except built-in speed reducer)
Speedway Mfg. Co., Cicero, Ill.
Sturtevant, B. F., Co., Hyde Park, Mass.
United Electrical Mfg. Co., Adrian, Mich. (except built-in speed reducer)
Victor Electric Products, Inc., Cincinnati, Ohio (except built-in speed reducer)
Wagner Electric Corp., St. Louis.
Warren Telechron Co., Ashland, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, SPLIT PHASE, A.C.**
*Obtainable in fractional hp. sizes, foot or flanged mounted, splash-proof, inclosed or explosion proof, and with built-in speed reducers, except where noted otherwise.*

**Alliance Mfg. Co., Alliance, Ohio**
Baldor Electric Co., St. Louis, Mo. (except explosion proof and built-in speed reducer)
Black & Decker Electric Co., Kent, Ohio (foot and flange mountings, inclosed and built-in speed reducer)
Bodine Electric Co., 2254 W. Ohio, Chicago (except explosion proof)
Brown-Brockmeyer Co., Dayton, Ohio
Century Electric Co., St. Louis, Mo. (except explosion proof)
**Delco Appliance Div., General Motors Sales Co., 391 Lyell Ave., Rochester, N. Y.**
Diehl Mfg. Co., Elizabethport, N. J. (except built-in speed reducers)
Electric Specialty Co., Stamford, Conn. (except explosion proof)
Emerson Electric Mfg. Co., St. Louis, Mo
Fidelity Electric Co., Lancaster, Pa. (foot mountings, open and inclosed types only)
Forbes and Myers, Worcester, Mass. (except built-in speed reducer)
**General Electric Co., Schenectady, N. Y.**
Holtzer-Cabot Electric Co., 125 Amory St.. Boston, Mass. (except explosion proof and built-in speed reducer)
Howell Electric Motors Co., Howell, Mich. (except explosion proof and built-in speed reducer)
Janette Mfg. Co., 556 W. Monroe, Chicago
Kingston-Conley Electric Co., 68 Brook Ave., N. Plainfield, N. J. (except built-in speed reducer)
Leland Electric Co., Dayton, O.
Ohio Electric Mfg. Co., Cleveland (except built-in speed reducer)
**Peerless Electric Co., Warren, Ohio** (Foot mounting, open and inclosed types only)
Reynolds Electric Co., 2650 W. Congress, Chicago (foot and flange mountings, open type only)
Robbins & Myers, Inc., Springfield, Ohio
Russell Electric Co., 340 W. Huron St., Chicago
Star Electric Motor Co., Bloomfield, N. J.
Sunlight Electrical Co., Warren, Ohio (except built-in speed reducer)
Wagner Electric Corp., St. Louis, Mo. (except explosion proof)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, A.C., SQUIRREL CAGE**
*Obtainable in all sizes, foot or flange mountings, splash proof, inclosed or explosion proof, built-in speed reducer, except where noted otherwise.*

Advance Electric Co., St. Louis, Mo. (only open and foot mounting types)
**Alliance Mfg. Co., Alliance, Ohio**
Allis Co., Louis, Milwaukee, Wis.
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Armor Electrical Mfg. Co., Erie Pa.
Baldor Electric Co., St. Louis, Mo. (except explosion proof and built-in speed reducer)
Brown-Brockmeyer Co., Dayton, Ohio
Burke Electric Co., Erie, Pa. (except built-in speed reducer)
Century Electric Co., St. Louis, Mo.
Cleveland Electric Motor Co., Cleveland, Ohio (except explosion proof)
Continental Electric Co., 325 Ferry, Newark, N. J.
**Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.**
**Delco Appliance Div. Genmotors Sales Corp., 391 Lyell Ave., Rochester, N. Y.**
Diehl Mfg. Co., Elizabethport, N. J.
Electric Products Co., Cleveland, Ohio (except built-in speed reducer)
Electric Specialty Co., Stamford, Conn. (except explosion proof)
Electro Dynamic Works, Bayonne, N. J.
Elliott Co., Jeanette, Pa. (except built-in speed reducer)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago (except explosion proof)
Fidelity Electric Co., Lancaster, Pa. (only open and inclosed types with foot mounting)
Forbes & Myers, Worcester, Mass. (except built-in speed reducer)
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor, Elyria, Ohio**
Harnischfeger Sales Corp., Milwaukee, Wis. (except explosion proof and built-in speed reducer)
Hertner Electric Co., Cleveland (except explosion proof and built-in speed reducer)
Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.
Howell Electric Motors Co., Howell, Mich.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Imperial Electric Co., Akron, Ohio
Janette Mfg. Co., 556 W. Monroe, Chicago
Kimble Electric Co., 2011 Hastings, Chicago (except explosion proof and built-in speed reducer)
Kingston-Conley Electric Co., 68 Brook Ave, N. Plainfield, N. J. (fractional hp. only)
Leland Electric Co., Dayton, Ohio (fractional hp. only)
Lincoln Electric Co., Cleveland, Ohio (except explosion proof)
Marble-Card Electric Co., Gladstone, Mich. (except explosion proof)
Master Electric Co., Dayton, Ohio
Ohio Electric Mfg. Co., Cleveland, Ohio
**Peerless Electric Co., Warren, Ohio** (except explosion proof and built-in speed reducer)
Reliance Electric & Engineering Co., Cleveland
Robbins & Myers, Inc., Springfield, Ohio
Russell Electric Co., 340 W. Huron, Chicago
Smith, F. A., Mfg. Co., Inc., Rochester, N. Y.
Star Electric Motor Co., Bloomfield, N. J.
Sterling Electric Motors, Inc., Los Angeles, Calif. (except explosion proof)
Sturtevant Co., B. F., Hyde Park, Mass. (except explosion proof and built-in speed reducer)
U. S. Electrical Motors, Inc., Los Angeles, Calif.
Valley Electric Corp., St. Louis, Mo. (except built-in speed reducer)
Wagner Electric Corp., St. Louis, Mo.
Walter Electric Mfg. Co., Norfolk, Va.
Wesche Electric Co., B. A., Cin-

***For further information on companies listed***

cinnati (except explosion proof and built-in speed reducer)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Woods Machine Co., S. A., Boston, Mass. (except built-in speed reducer)
Yates-American Machine Co., Beloit, Wis. (except explosion proof and built-in speed reducer)
Zobell Electric Motor Co., Garwood, N. J. (except built-in speed reducer)

**MOTORS, SYNCHRONOUS A.C., MINIATURE**

Barber-Colman Co., Rockford, Ill.
Bodine Electric Co., 2254 W. Ohio, Chicago
Brown-Brockmeyer Co., Inc., Dayton, Ohio
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor, Elyria, Ohio**
Hansen Mfg Co., Princeton, Ind.
Holtzer-Cabot Electric Co., 125 Armory, Boston, Mass.
Janette Mfg. Co., 556 W. Monroe, Chicago
Meissner Mfg. Co., 2817 W. 19th, Chicago
Reynolds Electric Co., 2650 W. Congress, Chicago
Signal Electric Mfg. Co., Menominee, Mich.
Speedway Mfg. Co., Cicero, Ill.
Victor Electric Products, Cincinnati, Ohio
Waltham Watch Co., Waltham, Mass.
Warren Telechron Co., Ashland, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**MOTORS, TORQUE**

*Used for exerting high torque with rotor locked*

**Alliance Mfg. Co., Alliance, Ohio**
Allis, Louis, Co., Milwaukee, Wis.
Baldor Electric Co., St. Louis, Mo.
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Burke Electric Co., Erie, Pa.
Century Electric Co., 1806 Pine, St. Louis, Mo.
Diehl Mfg. Co., Elizabethport, N. J.
**General Electric Co., Schenectady, N. Y.**
Holtzer-Cabot Electric Co., 125 Amory, Boston, Mass.
Imperial Electric Co., Akron, Ohio
Master Electric Co., Dayton, Ohio
Ohio Electric Mfg. Co., Cleveland, Ohio
**Peerless Electric Co., Warren, Ohio**
Reliance Electric & Engineering Co., Cleveland, Ohio
Sterling Electric Motors, Inc., Los Angeles, Calif.
U. S. Electrical Motors, Inc., Los Angeles, Calif.
Valley Electric Corp., St. Louis, Mo.
Wesche, B. A., Electric Co., Cincinnati, Ohio
Wagner Electric Corp., St. Louis, Mo.

**MOTORS, UNIVERSAL**

*Obtainable in fractional hp. sizes, foot or flange mounting, splash proof, inclosed or explosion proof, built-in speed reducer, except where noted otherwise*

Bodine Electric Co., 2254 W. Ohio, Chicago (except explosion proof)
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Burke Electric Co., Erie, Pa. (except built-in speed reducer)
**Delco Appliance Corp., Rochester, N. Y.** (except built-in speed reducer)
Diehl Mfg. Co., Elizabethport, N. J. (except built-in speed reducer)
Dumore Co., Racine, Wis. (except explosion proof)
Electric Motor Corp., Racine, Wis.
Electric Specialty Co., Stamford, Conn. (except explosion proof)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fidelity Electric Co., Lancaster, Pa. (except explosion proof and built-in speed reducer)
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor, Elyria, Ohio**
Gilbert Co., A. C., New Haven, Conn.
Hamilton Beach Co., Racine, Wis. (except built-in speed reducer)
Heinze Electric Co., Lowell, Mass. (except built-in speed reducer)
Howell Electric Motors Co., Howell, Mich. (except explosion proof and built-in speed reducer)
Janette Mfg. Co., 556 W. Monroe, Chicago (except explosion proof)
Kendrick & Davis Co., Lebanon, N. H.
Leland Electric Co., Dayton, Ohio
**Peerless Electric Co., Warren, Ohio**
Reynolds Electric Co., 2650 W. Congress, Chicago
Robbins & Myers, Inc., Springfield, Ohio (except explosion proof)
Signal Electric Mfg. Co., Menominee, Mich.
Speedway Mfg. Co., Cicero, Ill.
Sturtevant, B. F., Co., Hyde Park, Mass. (except explosion proof and built-in speed reducer)
United Electrical Mfg. Co., Adrian, Mich. (except built-in speed reducer)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

*in bold face type, see index on last page*

MOTORS
of Special Design

TEXTILE loom motors; splash-proof motors for dairies and wet places; vertical motors—these are only a few of the special designs Peerless has available. Peerless builds special motors for grinders, pumps and equipment of all kinds Range of sizes ¼ to 10 horsepower Send us your drawings and specifications.

THE Peerless ELECTRIC CO.
WARREN, OHIO

### MOTORS, A.C., WOUND ROTOR

*Obtainable in all sizes, foot or flange mounting, splash-proof, inclosed or explosion proof, built-in speed reducer, except where noted otherwise*

Advance Electric Co., St. Louis, Mo. (Foot mountings only)
**Alliance Mfg. Co., Alliance, Ohio.**
Allis, Louis, Co., Milwaukee, Wis.
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Armor Electric Mfg. Co., Erie, Pa.
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Burke Electric Co., Erie, Pa. (except built-in speed reducer)
Century Electric Co., St. Louis, Mo. (except explosion proof)
Cleveland Electric Motor Co., Cleveland, Ohio (except explosion proof)
Continental Electric Co., 325 Ferry, Newark, N. J.
**Crocker - Wheeler Electric Mfg. Co., Ampere, N. J.**
Diehl Mfg. Co., Elizabethport, N. J. (except built-in speed reducer)
Electric Products Co., Cleveland, Ohio (except built-in speed reducer)
Electric Specialty Co., Stamford, Conn.
Electro Dynamic Works, Bayonne, N. J.
Elliott Co., Jeannette, Pa. (except built-in speed reducer)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago (except explosion proof)
Fidelity Electric Co., Lancaster, Pa. (except explosion proof and built in speed reducer)
**General Electric Co., Schenectady, N. Y.**
Harnischfeger Sales Corp., Milwaukee, Wis. (except explosion proof and built-in speed reducer)
Hertner Electric Co., Cleveland (except explosion proof and built-in speed reducer)
Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.
Howell Electric Motors Co., Howell, Mich. (except explosion proof)
Ideal Electric & Mfg. Co., Mansfield, Ohio
Imperial Electric Co., Akron, Ohio
Janette Mfg. Co., 256 W. Monroe St., Chicago, Ill.
Kimble Electric Co., 2011 Hastings, Chicago (except explosion proof and built-in speed reducer)
Lincoln Electric Co., Cleveland, Ohio (except explosion proof)
Marble-Card Electric Co., Gladstone, Mich. (except explosion proof and built-in reducer)
Master Electric Co., Dayton, Ohio
**Peerless Electric Co., Warren, Ohio**
Reliance Electric & Engineering Co., Cleveland (except explosion proof)
Star Electric Motor Co., Bloomfield, N. J.
Sterling Electric Motors, Inc., Los Angeles, Calif. (except explosion proof)
Sturtevant, B. F., Co., Hyde Park, Mass (foot mounting types only)
U. S. Electrical Motors, Los Angeles, Calif.
Wagner Electric Corp., St. Louis, Mo. (foot mounting and built-in speed reducer types only)
Wesche, B. A., Electric Co., Cincinnati, Ohio (except explosion proof)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Zobell Electric Motor Co., Garwood, N. J. (except built-in speed reducer)

### MOTORS, D.C. FRACTIONAL HP. UP TO ¾ HP.

**Alliance Mfg. Co., Alliance, Ohio**
Baldor Electric Co., St. Louis, Mo.
Bodine Electric Co., 2254 W. Ohio, Chicago
Brown-Brockmeyer Co., Inc., Dayton, Ohio
Burke Electric Co., Erie, Pa.
Century Electric Co., 1806 Pine, St. Louis, Mo.
Continental Electric Co., Inc., 325 Ferry, Newark, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
Dumore Co., Racine, Wis.
**General Electric Co., Schenectady, N. Y.**
Holtzer-Cabot Electric Co., 125 Amory, Boston, Mass.
Janette Mfg., 556 W. Monroe, Chicago
Leland Electric Co., Dayton, Ohio
Master Electric Co., Dayton, Ohio
Ohio Electric Mfg. Co., Cleveland, Ohio
**Peerless Electric Co., Warren, Ohio**
Wagner Electric Corp., St. Louis, Mo.

### MOTORS, D.C. INTEGRAL HP.

*Obtainable in all sizes, foot or flanged mounted, splash-proof, inclosed or explosion proof and with built-in speed reducers, except where noted otherwise.*

**Alliance Mfg., Co., Alliance, Ohio**
Allis Co., Louis, Milwaukee, Wis.
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Baldor Electric Co., St. Louis, Mo. (except explosion proof and built-in speed reducers)
Black & Decker Electric Co., Kent, Ohio (fractional hp. only)
Bodine Electric Co., 2254 West Ohio, Chicago (except explosion proof)
Brown-Brockmeyer Co., Dayton, Ohio
Burke Electric Co., Erie, Pa. (except built-in speed reducer)
Century Electric Co., St. Louis, Mo. (except explosion proof)
Continental Electric Co., Inc., 325 Ferry, Newark, N. J.
**Crocker - Wheeler Electric Mfg. Co., Ampere, N. J.**
**Delco Products Corp., Dayton, Ohio**
Diehl Mfg. Co., Elizabethport, N. J., (except built-in speed reducer)
Electric Motor Corp., Racine, Wis.
Electric Products Co., Cleveland, Ohio (except built-in speed reducer)
Electric Specialty Co., Stamford, Conn. (except explosion proof)
Electro Dynamic Works, Bayonne, N. J. (except explosion proof)
Elliott Co., Jeannette, Pa., (except built-in speed reducer)
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago (except explosion proof)
Fidelity Electric Co., Lancaster, Pa. (except flange mounting, explosion proof and built-in speed reducer)
Forbes & Myers, Worcester, Mass. (except built-in speed reducers)
**General Electric Co., Schenectady, N. Y.**
**General Industries Co., 3744 Taylor St., Elyria, Ohio** (fractional hp. only)
Hamilton Beach Co., Racine, Wis. (fractional hp. only)
Harnischfeger Sales Corp., Milwaukee, Wis. (except explosion proof and built-in speed reducer)
Heinze Electric Co., Lowell, Mass. (except built-in speed reducer)
Hertner Electric Co., Cleveland (except explosion proof and built-in speed reducer)
Holtzer-Cabot Electric Co., Roxbury, Mass. (except explosion proof and built-in speed reducer)
Howell Electric Motors Co., Howell, Mich. (except explosion proof)
Ideal Electric & Mfg. Co., Mansfield, Ohio
Imperial Electric Co., Akron, Ohio (except explosion proof)
Janette Manufacturing Co., 556 West Monroe, Chicago
Kendrick & Davis Co., Lebanon, N. H. (fractional hp. only)
Kimble Electric Co., 2011 W. Hastings Chicago (except explosion proof and built-in speed reducer)
Leland Electric Co., Dayton, Ohio
Marble-Card Electric Co., Gladstone, Mich. (except explosion proof)
Master Electric Co., Dayton, Ohio
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. (fractional hp. only)
Ohio Electric Mfg. Co., Cleveland, Ohio (except built-in speed reducer)
**Peerless Electric Co., Warren, Ohio** (except explosion proof and built-in speed reducer)
Reliance Electric & Eng. Co., Cleveland.
Reynolds Electric Co., 2650 W. Congress, Chicago (except inclosed and explosion proof)
Robbins & Myers, Inc., Springfield, Ohio
Signal Electric Mfg., Co., Menominee, Mich. (fractional hp. only)
Speedway Mfg. Co., Cicero, Ill. (fractional hp. only)
Star Electric Motor Co., Bloomfield, N. J.
Stow Mfg., Co., Inc., Binghamton, N. Y. (except flange mounting, explosion proof and built-in speed reducer)
Sturtevant, B. F. Co., Hyde Park, Mass. (open frame and foot mounting only)
United Electrical Mfg. Co., Adrian, Mich. (fractional hp. only except built-in speed reducer)
Wagner Electric Corp., St. Louis, Mo. (except explosion proof)
Wesche Electric Co., B. A., Cincinnati (except explosion and built-in speed reducer)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Zobell Electric Motor Co., Garwood, N. J. (except built-in speed reducer)

### MOTOR-GENERATOR SETS

**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
B-L Electric Mfg. Co., 1832 Washington Blvd., St. Louis, Mo.
Bodine Electric Co., 2260 W. Ohio, Chicago
**Crocker-Wheeler Mfg. Co., Ampere, N. J.**
Diehl Mfg. Co., Elizabethport, N. J.
Electric Products Co., 1725 Clarkstone Rd., Cleveland, Ohio
Electric Specialty Co., Stamford, Conn.
Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago
Holtzer-Cabot Electric Co., 125 Amory, Boston, Mass.

***For further information on companies listed***

Ideal Electric & Mfg. Co., Mansfield, Ohio
Imperial Electric Co., Akron, Ohio
Janette Mfg. Co., 556 W. Monroe, Chicago
Leland Electric Co., Dayton, Ohio
Master Electric Co., Dayton, Ohio
Ohio Electric & Mfg. Co., Cleveland, Ohio
**Peerless Electric Co., Warren, Ohio**
Reliance Electric & Engineering Co., Cleveland, Ohio
Robbins & Myers, Inc., Springfield, Ohio
**Square D Co., Detroit, Mich.**
Star Electric Motor Co., Bloomfield, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### MOTOR REDUCERS

*Motors with built-in speed reducers. See under type of motor desired.*

### MOTOR STARTERS

*Remote controlled magnetic switches operated by pilot circuits.*

Allen-Bradley Co., Milwaukee, Wis.
**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Arrow-Hart & Hegemen Electric Co., Hartford, Conn.
Automatic Reclosing Circuit Breaker Co., Columbus, Ohio
Clark Controller Co., Cleveland, Ohio
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
Condit Electrical Mfg. Corp., Hyde Park, Boston, Mass.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
**Dunn, Struthers, Inc., Philadelphia, Pa.**
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio.
Electric Machinery Co., Minneapolis, Minn.
Fairbanks, Morse & Co., 900 S. Wabash Avenue., Chicago
**General Electric Co., Schenectady, N. Y.**
Ideal Electrical Co., Mansfield, Ohio
Kolton Electric Mfg. Co., Newark, N. J.
Lincoln Electric Co., Cleveland, Ohio
Monitor Controller Co., Baltimore, Md.
Rowan Controller Co., Baltimore, Md.
**Square D Co., Detroit, Mich.**
Trumbull Electric Mfg. Co., Plainville, Conn.
Ward Leonard Electric Co., Mount Vernon, N. Y.,
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### MOULDINGS, METAL

*Rolled from sheet or strip stock*

Dahlstrom Metallic Door Co., Jamestown, N. Y.
Jamestown Metal Corp., Jamestown, N. Y.
Lees, John, Div. of Serrick Corp., Muncie, Ind.
Pyramid Metals Co., 463 N. Oakley Blvd., Chicago
**Swanson Machine Co., Jamestown, N. Y.**

### NAILS, Hardened, Screw or Helix

(*See Screws, Drive*)

### NAMEPLATES AND ESCUTCHEONS

*Embossed, stamped, etched and other types*

**Aluminum Goods Mfg. Co., Manitowoc, Wis.**
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
**American Emblem Co., Inc., Box 116 E., Utica, N. Y.**
American Name Plate & Mfg. Co., 824 S. Tripp Ave., Chicago
Baltimore Enamel & Novelty Co., Box 928, Baltimore, Md.
Corbin Cabinet Lock Co., New Britain, Conn.
Crowe Name Plate & Mfg. Co., 1767 Grace, Chicago
Dickey-Grabler Co., 10302 Madison Ave., Cleveland, Ohio
Dura Products Mfg. Co., Canton, Ohio
Etching Company of America, 1520 Montana, Chicago
Formica Insulation Co., 4620 Spring Grove Ave., Cincinnati, Ohio
Fox Co., Fox Bldg., Cincinnati, Ohio
Grammes, L. F., & Sons, Inc., Allentown, Pa.
Ingraham-Richardson Mfg. Co., Beaver Falls, Pa.
Premier Metal Etching Co., Long Island City, N. Y.
Schwerdtle Stamp Co., Bridgeport, Conn.
Whittier, Horace R., Co., Pequabuck, Conn.

### NICKEL SILVER

*Sheets, strips, rods, wire, extruded shapes and tubing*

**American Brass Co., Waterbury, Conn.**
American Nickeloid Co., Peru, Ill.
Apollo Metal Works, 6601 S. Oak Park Ave., Chicago
Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Conklin, T. E., Brass & Copper Co., Inc., 54 Lafayette, New York

*in bold face type, see index on last page*

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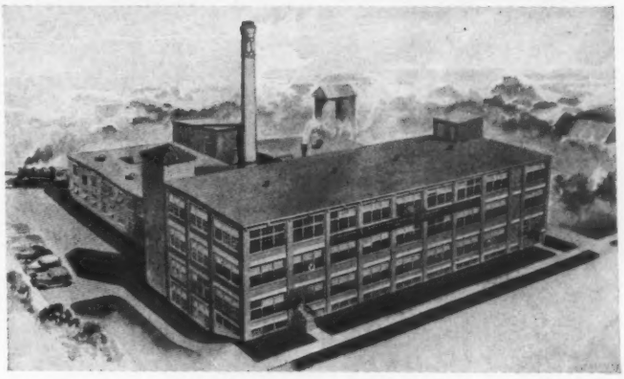

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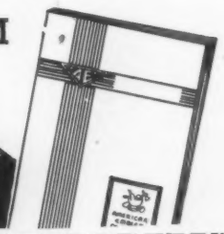
AMERICAN EMBLEM Co., Inc.
Utica, New York



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**NICKEL, SILVER (Cont.)**

Driver, Wilbur B., Co., 150 Riverside Ave., Newark, N. J.
Eagle Brass Foundry Co., 21 Spokane, Seattle, Wash.
Federated Metals Corp., 120 Broadway, New York
Handy & Harman Co., Fulton St., New York
Mueller Brass Co., Port Huron, Mich.
Niagara Falls Smelting & Refining Corp., Buffalo, N. Y.
Plume & Atwood Mfg. Co., Waterbury, Conn.
Pusey & Jones Corp., Wilmington, Del.
Revere Copper & Brass, Inc., 230 Park Ave., New York
Riverside Metal Co., Riverside, N. J.
**Scovill Mfg. Co., Waterbury, Conn.**
Seymour Mfg. Co., Seymour, Conn.
Western Cartridge Co., East Alton, Ill.
Wilson, M. G., & G. N. Nutwell, 140 Calish, Fresno, Calif.

**NITRIDING STEELS**

Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
Crucible Steel Co. of America, 405 Lexington Ave., New York
Ludlum Steel Co., Watervliet, N. Y.
Mitchell Steel Co., Cincinnati, Ohio
Republic Steel Corp., Cleveland, Ohio
Sharon Steel Hoop Co., Sharon, Pa.
Simonds Saw & Steel Co., Lockport, N. Y.

**NUTS, LOCKING TYPES**

*Including thread locking devices for prevention of loosening through vibration*

**American Screw Co., Providence, R. I.**
Automatic Nut Corp., Lebanon, Pa.
Boss Bolt & Nut Co., 3403 W. 47th, Chicago
**Corbin Screw Corp., New Britain, Conn.**
Dardalet Threadlock Corp., 55 Liberty, New York
Drake Lock-Nut Co., Cleveland, Ohio
Elastic Stop Nut Corp., Elizabeth, N. J.
Industrial Lock Nut Co., S. Hanover, Mass.
Hartford Machine Screw Co., Hartford, Conn.
Machinery Products Corp., 2020 N. Major Ave., Chicago
National Machine Products Co., Detroit, Mich.
**National Screw & Mfg. Co., Cleveland, Ohio**
Neeley Nut & Bolt Co., Pittsburgh, Pa.
Palnut Co., 65 Cordier, Irvington, N. J.
Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.
Rawlplug Co., Inc., 98 Lafayette, New York
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Safety Nut Corp., Philadelphia, Pa.
SKF Industries, Inc., Philadelphia, Pa.
**Standard Pressed Steel Co., Jenkintown, Pa.**
**Tinnerman Stove & Range Co., Cleveland, Ohio** (Special for sheet metal)

**NUTS, WING**

Atlas Bolt & Screw Co., Cleveland, Ohio
Billings & Spencer Co., 1 Laurel, Hartford, Conn.
Blake & Johnson, Waterville, Conn.
Central Screw Co., 3501 Shields Ave., Chicago
Chicago Screw Co., 1026 S. Homan Ave., Chicago
Clark Bros Bolt Co., Milldale, Conn.
**Continental Screw Co., 459 Mt. Pleasant, New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
Dardalet Threadlock Corp., 55 Liberty, New York
Elastic Stop Nut Corp., Elizabeth, N. J.
Harper, H. M., Co., 2620 Fletcher, Chicago
Hartford Machine Screw Co., Hartford, Conn.
Haskell, Wm. H., Mfg. Co., Pawtucket, R. I.
Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.
**Lamson & Sessions Co., Cleveland, Ohio**
**National Lock Washer Co., Newark, N. J.**
**National Screw & Mfg. Co., Cleveland, Ohio**
**Parker-Kalon Corp., 200 Varick, New York**
Pawtucket Mfg. Co., Pawtucket, R. I.
Pheoll Mfg. Co., 5700 Roosevelt Road, Chicago
Reed & Prince Mfg. Co., Worcester, Mass.
Republic Steel Corp., Cleveland, Ohio
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
St. Louis Screw & Bolt Co., St. Louis, Mo.

***For further information on companies listed***


**DESIGNERS APPROVE** OF THE NEAT, FINISHED LOOK

Fig. 1513
Pat'd & Pat's Pending

A built-in locking ring springs into life when backing off starts and grips the bolt or stud with an unfailing tenacity. Yet an ordinary wrench is the only tool needed to easily remove the nut when needed. Specify "Unshako".

UNSHAKO

**SELF-LOCKING NUTS WILL ADD TO ANY PRODUCT**

No unsightly cotter pins or washers are needed to hold the *"Unshako"* absolutely tight on a bolt or stud. Vibration, jarring or shaking motions are helpless against the grip this nut takes, yet in appearance, it is little different from the ordinary hex nut. A locking ring, made as an integral part of the nut prevents its backing off.

The next time the design requires nuts that can't shake loose . . . specify *"Unshako."*

**STANDARD PRESSED STEEL CO.**

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.
Box 545

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio
**Williams, J. H., & Co., 400 Vulcan, Buffalo, N. Y.**
Wrightsville Hardware Co., Wrightsville, Pa.

### NUTS, WELDING

*Made with projections for resistance welding to sheets.*

Ohio Nut & Bolt Co., 600 Front, Berea, Ohio

### OIL HOLE COVERS

Bay State Stamping Co., Worcester, Mass.
Fauver, Inc., J. N., Co., 91 Selden Ave., Detroit, Mich.
**Gits Bros. Mfg. Co 1846 S. Kilbourn Ave., Chicago**

### PACKINGS, ASBESTOS

Auburn Mfg. Co., Middletown, Conn.
Belmont Packing & Rubber Co., Butler and Sepviva, Philadelphia.
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
Detroit Gasket & Mfg., Detroit, Mich.
**Garlock Packing Co., Palmyra, N. Y.**
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
New York Belting & Packing Co., Passaic, N. J.
Thermoid Rubber Div., Thermoid Co., Trenton, N. J.
U. S. Rubber Products, Inc., 1790 Broadway, New York
Victor Mfg. & Gasket Co., 1059 S. Menard Ave., Chicago
Wolverine Gasket Co., Inc., 3526 W. Fort, Detroit, Mich.

### PACKINGS, LEATHER

Alexander Bros., Inc., 406 N. 3rd, Philadelphia, Pa.
Auburn Mfg. Co., Middletown, Conn.
Belmont Packing & Rubber Co., Butler and Sepviva, Philadelphia, Pa.
Bonner & Barnewall, Inc., 92 Bleecker, New York
Chicago Belting Co., 117 N. Green, Chicago
Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago
Cincinnati Gasket & Packing Co., 1507 Elm, Cincinnati, Ohio

*in bold face type, see index on last page*


## EVERY EFFORT . . .

. . . has been made to incorporate in this Directory all items ordinarily specified by design engineers.

If, however, you can't find what you want, drop us a line. We'll try to help locate it.

**PRODUCT ENGINEERING**
330 West 42nd St., New York, N. Y.

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NAILS, RIVETS & SCREWS

Made to order in any metal regardless of quantity.
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**JOHN HASSALL, INC.**
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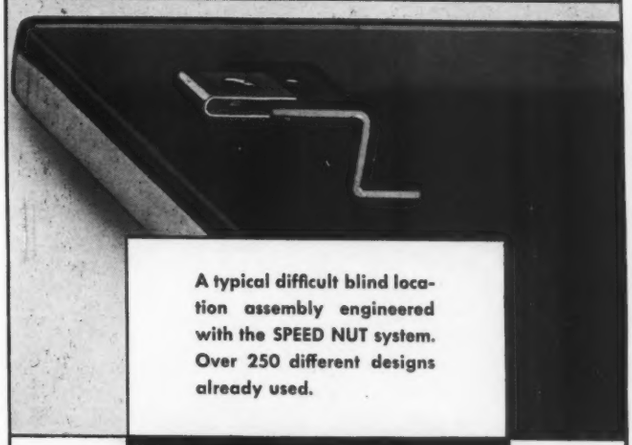
HAVE YOU modernized your assembly with Speed Nuts?

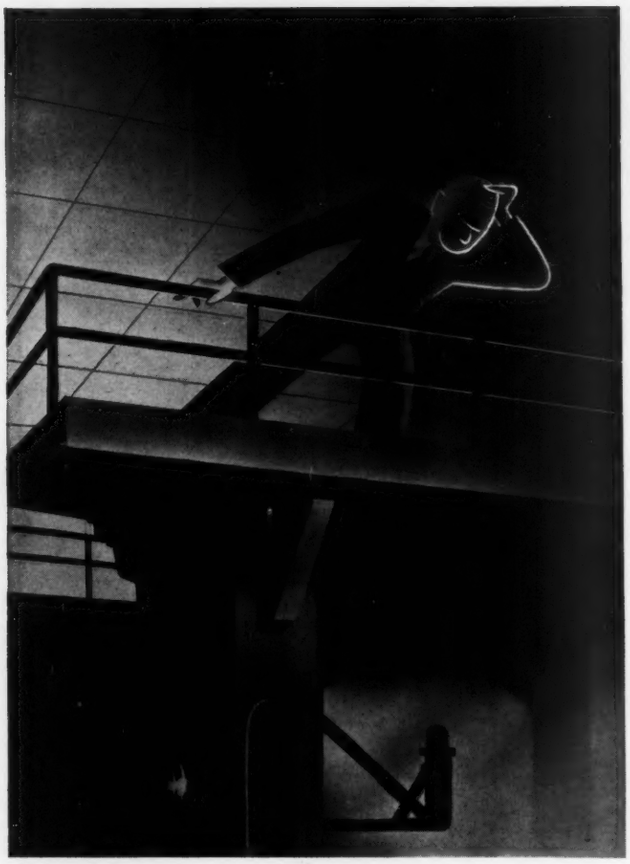


A typical difficult blind location assembly engineered with the SPEED NUT system. Over 250 different designs already used.

Z angle clip welded to one member of blind location assembly. SPEED NUT slipped over edge of clip retains itself in bolt receiving location under spring tension.

- In your engineering work, do not overlook the help available to you from our engineering development department. It is devoted solely to helping you solve your assembly problems with the SPEED NUT system.
- The SPEED NUT has become the modern fastening means. Manufactured from spring steel, cold rolled steel, phosphor bronze or stainless steel, depending on requirements. It takes the place of the nut and lock washer in solving hundreds of assembly problems. It remains forever tight under spring tension. Over 250 different shapes and sizes are already in use, from little midgets for plastic assemblies to heavy SPEED NUTS for automobile fenders that will stand over 3000 lbs. pull.
- Regardless of the nature of the product you are designing or re-designing, it will pay you to investigate SPEED NUTS and the service available to you by our development engineering department. Write for further information today.

**SPEED NUT DIVISION**
TINNERMAN STOVE & RANGE CO.
2041 FULTON ROAD, CLEVELAND, OHIO



**A 75-ton Roll Press is not working right. The manufacturer thinks the packings are faulty. Trouble at the Packing Point! Our engineers check the job — discover the assembly does not adequately support the packings . . . consequently, they quickly become distorted — refuse to function. The press is useless. But the packings are not at fault.**

# He didn't need our product . . . he needed our advice

Graton & Knight engineers tell the press owner that special fillers, plus a properly designed metal plate at the Packing Point*, will support the packings — and the press will work.

The suggested change is inexpensive, so he tries it . . . and now his press does its job satisfactorily.

Problems like this one are everyday affairs with Graton & Knight engineers . . . who usually solve them with the combination of "X-Ray" Thinking and Home of Research Leathers . . . especially tanned to resist water, oil, semi-corrosive liquids, heat, etc.

**Write for our new bulletin on Hydraulic and Pneumatic Packings.**

**The vital point in any machine using packings. In the design stage, call in Graton & Knight engineers.*

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**"X-Ray Thinking" at the Packing Point**


**PACKINGS, LEATHER (Cont.)**

**Garlock Packing Co., Palmyra, N. Y.**
Goetze Gasket & Packing Co., New Brunswick, N. J.
**Graton & Knight Co., Worcester, Mass.**
Hess & Hopkins Leather Co., Rockford, Ill.
Houghton, E. F. & Co., 240 W. Somerset, Philadelphia, Pa.
Marsh, C. W., Co., Muskegon, Mich.
Michigan Leather Packing Co., Detroit, Mich.
New York Belting & Packing Co.. Passaic, N. J.
Preston, Horace G. Co., Detroit, Mich.
Rhoads, J. E., & Sons, Philadelphia, Pa.
Schieren, C. A., Co., 29 Ferry, New York
U. S. Rubber Products, Inc., 1790 Broadway, New York
Warren Belting Co., Worcester, Mass.

**PACKINGS, METALLIC**

Belmont Packing & Rubber Co., Butler and Sepviva St., Philadelphia, Pa.
Cincinnati Gasket & Packing Co., 1507-09-11 Elm, Cincinnati, Ohio
**Crane Packing Co., 1818 Cuyler Ave., Chicago**
Felt Products Mfg. Co., 1506 Carroll Ave., Chicago
**Garlock Packing Co., Palmyra, N. Y.**
Rotary Seal Co., 809 W. Madison, Chicago (seals for rotating shafts)

**PACKINGS, RUBBER**

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge, Mass.
Cincinnati Gasket & Packing Co., 1507 Elm, Cincinnati, Ohio
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio
Continental Rubber Works., 1902 Liberty, Erie, Pa.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
**Garlock Packing Co., Palmyra, N. Y.**
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., Philadelphia, Pa.
Goodrich, B. F. Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Bros., 80 White, New York
Manhattan Rubber Mfg. Co., Passaic, N. J.
Mercer Rubber Co., Hamilton Square, N. J.
New York Belting & Packing Co., Passaic, N. J.
Quaker City Rubber Co., Philadelphia, Pa.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio
Sponge Rubber Products Co., Derby, Conn. (sponge rubber)
Thermoid Rubber Co., Trenton, N. J.
U. S. Rubber Products, Inc., 1790 Broadway, New York
Western Rubber Co., Goshen, Ind.

**PALLADIUM**

American Metal Co. Ltd., 61 Broadway, New York
American Platinum Works, Newark, N. J.
American Smelting & Refining Co., Equitable Bldg., New York
Baker & Co., Inc., 113 Astor, Newark, N. J.
Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.
Bishop, J., & Co., 12 Channing Ave., Malvern, Pa.
Goldsmith Bros. Smelting & Refining Co., 58 E. Washington, Chicago

**PERMANENT MAGNETS**

(*see Magnet Steel, Special alloys*)

**PILLOW BLOCKS, BALL BEARING**

*For drive-and counter-shafting*
Ahlberg Bearing Co., 321 E. 29th, Chicago
**Boston Gear Works, Inc., North Quincy, Mass.**
Dodge Mfg. Co., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Hill Clutch Machinery & Fdry. Co., Cleveland. Ohio
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Royersford Foundry & Machine Co., Royersford, Pa.
SKF Industries, Inc., Philadelphia, Pa.
Split Ballbearing Corp., Lebanon, N. H.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Sumner Iron Wks., Everett, Wash.
Wood's T. B. Sons Co., Chambersburg, Pa.
Watson-Flagg Machine Co., Paterson, N. J.

**PILLOW BLOCKS, ROLLER BEARING**

*For drive-and counter-shafting*
Fafnir Bearing Co., New Britain, Conn.

***For further information on companies listed***

Dodge Mfg. Corp., Mishawaka, Ind.
Hill Clutch Machinery & Foundry Co., Cleveland, Ohio
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Medart Co., The, 3500 De Kalb, St. Louis, Mo.
Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.
**Norma-Hoffmann Bearings Corp., Stamford, Conn.**
Palmer-Bee Co., Detroit, Mich.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Royersford Foundry & Machine Co., Royersford, Pa.
Shafer Bearing Corp., 6501 W. Grand Avenue., Chicago
SKF Industries, Inc., Philadelphia, Pa.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Sumner Iron Wks., Everett, Wash.
Watson-Flagg Machine Co., Paterson, N. J.

**PINS, COTTER**

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**American Chain Div., American Chain and Cable Co., Inc., Bridgeport, Conn.**
Atlas Bolt & Screw Co., 1130 Ivanhoe Rd., Cleveland, Ohio
Brooks, M. S., & Sons, Chester, Conn.
Eaton Mfg. Co., Massillon, Ohio
Hartford Machine Screw Co., Hartford, Conn.
Hubbard, M. D., Spring Co., Pontiac, Mich.
**National Screw & Mfg. Co., Cleveland, Ohio**
Rockford Bolt & Steel Co., Rockford, Ill.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Wire Products Co., St. Louis, Mo.

**PINS, DOWEL, STRAIGHT TAPERED**

**American Steel & Wire Co., 210 S. LaSalle, Chicago**
Brighton Screw & Mfg. Co., 1456 Harrison Ave., Cincinnati, Ohio
Chicago Screw Co., 1026 S. Homan Ave., Chicago
Federal Screw Works, 3401 Martin Ave., Detroit, Mich.
Groov-Pin Corp., 411 Kerrigan Ave., Union City, N. J.
Hartford Machine Screw Co., Hartford, Conn.
Moltrup Steel Products Co., Beaver Falls, Pa.
Oliver Iron & Steel Corp., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Standard Steel Specialty Co., Beaver Falls, Pa.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio

**PINS, GROOVED**

Groov-Pin Corp., 411 Kerrigan Ave., Union City, N. J.

**PIPE, BRASS AND COPPER**

(*see Tubing, Brass and Copper*)

**PIPE FITTINGS**

***Compression or Threadless Types***

**Dresser Mfg. Co., Bradford, Pa.**
Nugent, Wm. W., & Co., Inc., 410 N. Hermitage Ave., Chicago
Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio

**PLASTIC MATERIALS, CELLULOSE ACETATE MOLDING COMPOUNDS**

Celluloid Corp., 10 E. 40th, New York.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Fiberloid Corp., Indian Orchard, Mass.
**General Electric Co., Pittsfield, Mass.**
Masury, John W., & Son, 50 Jay Brooklyn, N. Y.
Tennessee Eastman Corp., Kingsport, Tenn.

**PLASTIC MATERIALS, CELLULOSE ACETATE**

*Sheets, rods and tubes*

**Bakelite Corp., 247 Park Ave., New York**
Celluloid Corp., 10 E. 40th, New York
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Fiberloid Corp., Indian Orchard, Mass.
Masury, John W., & Son, 50 Jay, Brooklyn, N. Y.

**PLASTIC MATERIALS, CELLULOSE NITRATE**

*Molding compounds, sheets, rods and tubes*

Celluloid Corp., 110 E. 40th, New York
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Fiberloid Corp., Indian Orchard, Mass.

**PLASTIC MATERIALS FOR COLD MOLDING**

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Durite Plastics Inc., Frankford, Philadelphia, Pa.
**General Electric Co., Pittsfield, Mass.**

*in bold face type, see index on last page*

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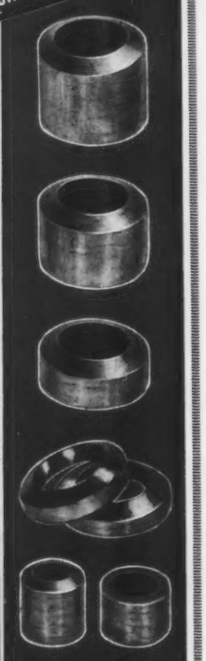

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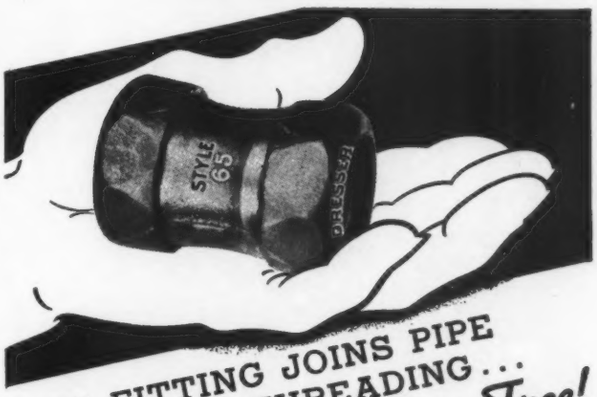


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Jobber's Name_____
and Address_____
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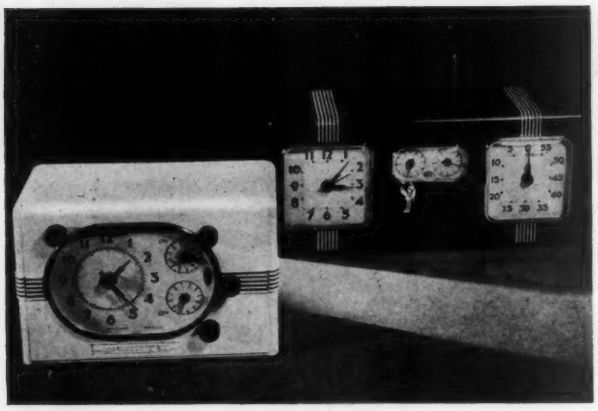

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Whether the job involves new materials and handling, a new design, or whether it's a routine job, to it is applied the knowledge acquired through years of pioneering experience. The result is a better job, often at less cost, handled efficiently and well, and delivered on time.

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AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Rochester, Boston

**PLASTIC MATERIALS, LAMINATED PHENOLIC RESINS**

*Sheets, bars and tubes*

**Bakelite Corp., 247 Park Ave., New York**
Continental Diamond Fibre Co., Newark, Del.
Formica Insulation Co., 4620 Spring Grove Ave., Cincinnati,
Franklin Fibre-Lamitex Corp., Wilmington, Del.
**General Electric Co., Pittsfield, Mass.**
Mica Insulator Co., 200 Varick, New York
National Vulcanized Fibre Co., E. Wilmington, Del.
**Richardson Co., Lockland, Cincinnati, Ohio**
Spaulding Fibre Co., Inc., Tonawanda, N. Y.
Synthane Corp., Oaks, Pa.
Taylor & Co., Norristown, Pa.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Zapon Div., Atlas Powder Co., Stamford, Conn.

**PLASTIC MATERIALS, PHENOLIC RESINS**

*Molding materials*

**Bakelite Corp., 247 Park Ave., New York**
Colasta Co., Inc., 1 Mechanic, Hoosick Falls, N. Y.
Durite Plastics Inc., Frankford, Philadelphia, Pa.
Fiberloid Corp., Indian Orchard, Mass.
**General Electric Co., Pittsfield, Mass.**
General Plastics, Inc., North Tonawanda, N. Y.
Reilly Tar & Chemical Corp., Indianapolis, Ind.
**Richardson Co., Lockland, Cincinnati, Ohio**
United-Carr Fastener Corp., Cambridge, Mass.

**PLASTIC MATERIALS, PHENOLIC RESINS**

*Rods, Sheets and Tubes*

Catalin Corp., 1 Park Ave., New York
Continental-Diamond Fibre Co., Newark, Del.
Fiberloid Corp., Indian Orchard, Mass.
Formica Insulation Co., 4620 Spring Grove Ave., Cincinnati, Ohio
Franklin Fibre-Lamitex Corp., Wilmington, Del.
**General Electric Co., Pittsfield, Mass.**

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New York Office: 75 West Street Phone Whitehall 4-4487

Mica Insulator Co., 200 Varick, New York, N. Y.
**Richardson Co., Lockland, Cincinnati, Ohio**
Synthane Corp., Oaks, Pa.
United-Carr Fastener Corp., Cambridge, Mass.
Wilmington Fibre Specialty Co., Wilmington, Del.

**PLASTIC MATERIAL, POLYSTRENE**

**Bakelite Corp., 247 Park Ave., New York**
**Dow Chemical Co., Midland, Mich.**
**Du Pont de Nemours, Inc., Wilmington, Del.**

**PLASTIC MATERIALS, RUBBER-BASE COMPOUNDS**

Advance Solvents & Chemical Co., 245 Fifth Ave., New York
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Firestone Tire & Rubber Co., Akron, Ohio
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
**Thiokol Corp., Yardville, N. J.**
U. S. Rubber Products, Inc., 1790 Broadway, New York

**PLASTIC MATERIALS UREA FORMALDEHYDE**

*Molding Materials*

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York
**Bakelite Corp., 247 Park Ave., New York**
**General Electric Co., Pittsfield, Mass.**
**Plaskon Co., Inc., 2120 Sylvan Ave., Toledo, Ohio**
**Richardson Co., Lockland, Cincinnati, Ohio**

**PLASTIC MOLDERS, CASEIN**

Kellogg Switchboard & Supply Co., 1066 W. Adams, Chicago
Lignotite Co., 2725 Archer Ave., Chicago
Northern Industrial Chemical Co., 12 Elkins, S. Boston, Mass.
Norton Laboratories, Inc., Lockport, N. Y.
Synthetic Plastics Co., Newark, N. J.

*in bold face type, see index on last page*

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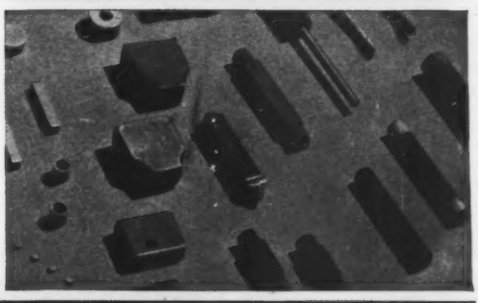

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### PLASTIC MOLDERS
### CELLULOSE ACETATE

Ackerman Rubber & Plastic Molding Co., 986 E. 200th, Cleveland, Ohio

American Insulator Corp., New Freedom, Pa.

**Auburn Button Works, Inc., Auburn. N. Y.**

Barber-Colman Co., Rockford, Ill.

Belmont Plastics, Inc., 2109 Reading Rd., Cincinnati, Ohio

Boonton Molding Co., 30 Church, New York

Chicago Molded Products Co., 2141 Walnut, Chicago

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

**Consolidated Molded Products Corp., Scranton, Pa.**

Diemolding Corp., Canastota, N. Y.

**Du Pont de Nemours & Co., Inc., Wilmington, Del.**

Fiberloid Corp., Indian Orchard, Mass.

**General Electric Co., Pittsfield, Mass.**

Gorham Co., Providence, R. I.

**General Industries Co., International Insulating Div., 500 Winckles, Elyria, Ohio**

Kellogg Switchboard & Supply Co., 1066 W. Adams, Chicago

Kurz-Kasch Co., Dayton, Ohio

Mack Molding Co., Wayne, N. J.

Molded Insulation Co., 3246 Ludlow, Philadelphia, Pa.

Norton Laboratories, Inc., Lockport, N. Y.

Recto Molded Products, Inc., Cincinnati, Ohio

Remler Co., Ltd., San Francisco, Calif.

Reynolds Spring Co., Jackson, Mich.

**Richardson Co., Lockland, Cincinnati, Ohio**

Shaw Insulator Co., Irvington, N. J.

Stokes, Jos., Rubber Co., Trenton, N. J.

Synthetic Moulded Products, Inc., Stonington, Conn.

Tech-Art Plastics, Long Island City, N. Y.

Universal Moulding Co., San Francisco, Calif.

**Waterbury Button Co., Waterbury, Conn.**

Watertown Mfg. Co., Watertown, Conn.

### PLASTIC MOLDERS
### CELLULOSE NITRATE

Chicago Molded Products Corp., 2141 Walnut, Chicago

**Du Pont de Nemours & Co., Inc., Wilmington, Del.**

Fiberloid Corp., Indian Orchard, Mass.

Recto Molded Products, Inc., Cincinnati, Ohio

Stokes Rubber Co., Trenton, N. J.

Watertown Mfg. Co., Watertown, Conn.

### PLASTIC MOLDERS
### COLD-MOLDING COMPOUNDS

American Insulator Corp., New Freedom, Pa.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Garfield Mfg. Co., Garfield. N. J.

**General Electric Co., Pittsfield, Mass.**

Norton Laboratories, Inc., Lockport, N. Y.

Specialty Insulation Mfg. Co., Hoosick Falls, N. Y.

### PLASTIC MOLDERS
### PHENOLIC RESINS

American Insulator Corp., New Freedom, Pa.

**Auburn Button Works, Inc., Auburn, N. Y.**

Barber-Colman Co., Rockford, Ill.

Boonton Molding Co., 30 Church, New York

Burke Electric Co., Erie, Pa.

Chicago Molded Products Co., 2141 Walnut, Chicago

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

**Consolidated Molded Products Corp., Scranton, Pa.**

Diemolding Corp., Canastota, N. Y.

**General Electric Co., Pittsfield, Mass.**

Gorham Co., Providence, R. I.

Imperial Molded Products Co., 2925 W. Harrison, Chicago

**General Industries Co., International Insulating Div., 500 Winckles, Elyria, Ohio**

Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago

Kuhn & Jacob Moulding & Tool Co., 1200 Southard, Trenton, N. J.

Kurz-Kasch Co., Dayton, Ohio

Mack Molding Co., Wayne, N. J.

Molded Insulation Co., 3246 Ludlow, Philadelphia, Pa.

Norton Laboratories, Inc., Lockport, N. Y.

Recto Molded Products, Inc., Cincinnati, Ohio

Remler Co., Ltd., San Francisco, Calif.

Reynolds Spring Co., Jackson, Mich.

**Richardson Co., Lockland, Cincinnati, Ohio**

Shaw Insulator Co., Irvington, N. J.

Stokes, Jos., Rubber Co., Trenton, N. J.


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Tech-Art Plastics, Long Island City, N. Y.
Universal Moulding Co., San Francisco, Calif.
**Waterbury Button Co., Waterbury, Conn.**
Watertown Mfg. Co., Watertown, Conn.

**PLASTIC MOLDERS PORCELAIN**

Ackerman Rubber & Plastic Molding Co., 986 E. 200th, Cleveland, Ohio
Akron Porcelain Co., Akron, Ohio
Cook-Ceramic, Inc., Box 180, Trenton, N. J.
**General Electric Co., Pittsfield, Mass.**

**PLASTIC MOLDERS PYROXYLIN**

**Auburn Button Works, Inc., Auburn, N. Y.**
Barber-Colman Co., Rockford, Ill.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Fiberloid Corp., Indian Orchard, Mass.
**Waterbury Button Co., Waterbury, Conn.**

**PLASTIC MOLDERS RUBBER**

American Hard Rubber Co., 11 Mercer, New York
Goodrich, B. F., Co., 522 S. Main, Akron, Ohio
**Richardson Co., Lockland, Cincinnati, Ohio**
Stokes, Jos., Rubber Co., Trenton, N. J.
Tech-Art Plastics, Long Island City, N. Y.
Universal Moulding Co., San Francisco, Calif.
**Waterbury Button Co., Waterbury, Conn.**
Western Rubber Co., Goshen, Ind.

**PLASTIC MOLDERS UREA FORMALDEHYDE**

Ackerman Rubber & Plastic Molding Co., 986 E. 200th Cleveland, Ohio
American Insulator Corp., New Freedom, Pa.
**Auburn Button Works, Auburn, N. Y.**
Barber-Colman Co., Rockford, Ill.
Boonton Molding Co., 30 Church, New York
Chicago Molded Products Co., 2141 Walnut, Chicago
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
**Consolidated Molded Products Co., Scranton, Pa.**
Diemolding Corp., Canastota, N. Y.
**General Electric Co., Pittsfield, Mass.**
**General Industries Co., International Insulating Div., 500 Winckles, Elyria, Ohio**
Gorham Co., Providence, R. I.
Imperial Molded Products Co., 2925 W. Harrison, Chicago
Kuhn & Jacob Moulding & Tool Co., 1200 Southard, Trenton, N. J.
Kurz-Kasch-Co., Dayton, Ohio
Mack Molding Co., Wayne, N. J.
Molded Insulation Co., 3246 Ludlow, Philadelphia, Pa.
Norton Laboratories, Inc., Lockport, N. Y.
**Plaskon Co., Inc., 2120 Sylvan Ave., Toledo, Ohio**
Recto Molded Products Inc., Cincinnati, Ohio
Remler Co., Ltd., San Francisco, Calif.
Reynolds Spring Co., Jackson. Mich.
**Richardson Co., Lockland, Cincinnati, Ohio**
Shaw Insulator Co., Irvington, N. J.
Stokes, Jos., Rubber Co., Trenton, N. J.
Tech-Art Plastics, Long Island City, N. Y.
Universal Molding Co., San Francisco, Cal.
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**PLATES, CARBON STEEL**

American Rolling Mills, Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
Central Iron & Steel Co., Harrisburg, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York
Disston, Henry, & Sons, Inc., Tacony, Philadelphia, Pa.
Granite City Steel Co., Granite City, Ill.
Ingersoll Steel & Disc. Co., New Castle, Ind.
Inland Steel Co., 38 S. Dearborn, Chicago
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Lukens Steel Co., Coatesville, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Otis Steel Co., Cleveland, Ohio
Republic Steel Corp., Cleveland, Ohio
Ryerson, Joseph T., & Son, 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Simonds Saw & Steel Co., Lockport, N. Y.
United Metals, 620 Hamilton, Spokane, Wash.

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**GENERAL INDUSTRIES CO.**
INTERNATIONAL INSULATING DIVISION
500 WINCKLES ST. ELYRIA, OHIO

**PLATES, CARBON STEEL (Cont.)**

Universal-Cyclops Steel Corp., Bridgeville, Pa.

**U. S. Steel Corp., 71 Broadway, New York**

**PLATES, FLOOR**

Acme Steel Co., 2840 Archer Ave., Chicago

Central Iron & Steel Co., Harrisburg, Pa.

**Columbia Steel Co., U. S. Steel Corp., Subsidiary, San Francisco, Cal.**

Crane Co., 836 S. Michigan Ave., Chicago

Driver-Harris Co., Harrison, N. J. (alloy)

Illinois Malleable Iron Co,. 1801 Diversey Parkway, Chicago

Inland Steel Co., 38 S. Dearborn, Chicago

Nekoosa Foundry & Machine Works, Inc., Nekoosa, Wis.

Ohio Rubber Co., Willoughby, Ohio

Riverside Foundry & Galvanizing Co., Kalamazoo, Mich.

Rockford Bolt & Steel Co., Rockford, Ill.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Universal-Cyclops Steel Corp., Bridgeville, Pa.

Winona Machine & Foundry Co., Winona, Minn.

**PLATES, HIGH AND LOW ALLOY STEEL**

Allegheny Steel Co., Brackenridge, Pa.

Central Iron & Steel Co., Harrisburg, Pa. (low alloy only)

Columbia Steel Co., U. S. Steel Corp., Subsidiary, San Francisco, Cal.

Crucible Steel Co. of America, 405 Lexington Ave., New York

Disston, Henry, & Sons, Inc., Tacony, Philadelphia, Pa.

Lukens Steel Co., Coatesville, Pa.

Ingersoll Steel & Disc Co., New Castle, Ind.

Inland Steel Co., 38 S. Dearborn, Chicago (low alloy only)

Republic Steel Corp., Cleveland. Ohio

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Simonds Saw & Steel Co., Lockport, N. Y.

Universal-Cyclops Steel Corp., Bridgeville, Pa.

**PLATES, NICKEL CLAD STEEL**

Allegheny Steel Co., Brackenridge, Pa.

Ingersoll Steel & Disc Co., New Castle, Ind.

Lukens Steel Co., Coatesville, Pa.

**PLATES, WROUGHT IRON**

Byers, A. M., Co., Pittsburgh, Pa.

**PLATINUM**

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark, N. J. (foil, gauage, sheet, wire, sponge)

American Smelting & Refining Co., Equitable Bldg., New York

Baker & Co., 113 Astor, Newark, N. J.

Bishop, J., & Co., 12 Channing Ave., Malvern, Pa. (wire, sheet, foil)

Goldsmith Bros. Smelting & Refining Co., 58 E. Washington, Chicago

Handy & Harman, 82 Fulton, New York (wire, sheet)

Williams Gold Refining Co., Buffalo, N. Y. (wire)

**Wilson, H. A., Co., Newark, N. J. (wire, sheet, solder)**

**PLUGS, APPLIANCE CONNECTOR**

*For use in attaching cords to heating appliances*

American Insulator Corp., New Freedom, Pa.

Arrow-Hart & Hegeman Electric Co., Harford, Conn.

Bryant Electric Co., Bridgeport, Conn.

Cutler-Hammer, Inc., Milwaukee, Wis.

Delta-Star Electric Co., 2400 Fulton, Chicago

Eagle Electric Mfg. Co., 59 Hall, Brooklyn, N. Y.

Edison, Thomas A., Inc., Orange, N. J.

**General Electric Co. Bridgeport, Conn.**

Hubbel, Harvey, Inc., Bridgeport, Conn.

Pyle-National Co., 1336 N. Kostner Ave., Chicago

U. S. Electric Mfg., Corp., 222 W. 14th, New York

**PLUGS, ATTACHMENT**

*Single and two part plugs for use in attaching cord connected appliances*

American Insulator Corp., New Freedom, Pa.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Beardsley & Wolcott Mfg. Co., Waterbury, Conn.

Belden Mfg. Co., W. Van Buren St., Chicago

Benjamin Electric Mfg. Co., Des Plaines, Ill.

Bryant Electric Co., Bridgeport, Conn.

Connecticut Electric Mfg. Co., Bridgeport, Conn.

Crouse-Hinds Co., Syracuse, N. Y.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Delta-Star Electric Co., 2400 Fulton, Chicago

**General Electric Co., Bridgeport, Conn.**

**Guardian Electric Mfg. Co., 1629 W. Walnut, Chicago**

Hubbel, Harvey, Inc., Bridgeport, Conn.

Pass & Seymour, Inc., Syracuse, N. Y.

U. S. Rubber Products, Inc., 1790 Broadway, New York

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**PORCELAIN MOLDED PARTS**

(*see Plastic Molders, Porcelain*)

**PORCELAIN ENAMEL**

*These companies apply porcelain vitreous fired enamel on parts submitted by the customer. Some of them are prepared to make the stampings or castings and also apply the porcelain finish.*

Baltimore Enamel & Novelty Co., Box 928, Baltimore, Md.

Beaver Enameling Co., Ellwood City, Pa.

Benjamin Electric Mfg. Co., Des Plaines, Ill.

California Metal Enameling Co., Los Angeles, Calif.

Chicago Hardware Foundry Co., North Chicago, Ill.

Chicago Vitreous Enamel Product Co., Cicero, Ill.

Davidson Enamel Products, Inc., Lima, Ohio

Day-Brite Lighting, Inc., 5401 Buliver Ave., St. Louis, Mo.

Enamel Products Co., Cleveland, Ohio

Ferro Enamel Corp., Cleveland, Ohio

Ferro Enameling Co., Oakland, Calif.

General Porcelain Enameling & Mfg. Co., 4101 Parker Ave., Chicago

Geuder, Paeschke & Frey Co., Milwaukee, Wis.

Hommel, O., & Co., Inc., Pittsburgh, Pa.

Ingram-Richardson Mfg. Co., Beaver Falls, Pa.

**Porcelain Enamel & Mfg. Co., Eastern & Pemco Aves, Baltimore, Md.**

Porcelain Metals Corp. of Louisville, Louisville, Ky.

Porcelain Metals, Inc., Long Island City, N. Y.

Tennessee Enamel Mfg. Co., Nashville, Tenn.

Texlite, Inc., Dallas, Tex.

Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Toledo Porcelain Enamel Products Co., Toledo, Ohio

U. S. Porcelain Enamel Co., Los Angeles, Calif.

Vesco Sales Corp., Sedgwick St., New York

Vitreous Steel Products Co., Cleveland, Ohio

**PULLEYS, FLAT BELT**

Alexander Bros., 406 N. 3rd, Philadelphia, Pa.

American Casting Co., 2140 Freeman Ave., Cincinnati, Ohio.

Beaird, J. B., Corp., Shreveport, La.

Bond Foundry & Machine Co., Manheim, Pa.

**Boston Gear Works, Inc., North Quincy, Mass.**

Chain Belt Co., 1600 W. Bruce, Milwaukee, Wis.

Chicago Belting Co., 117 N. Green, Chicago

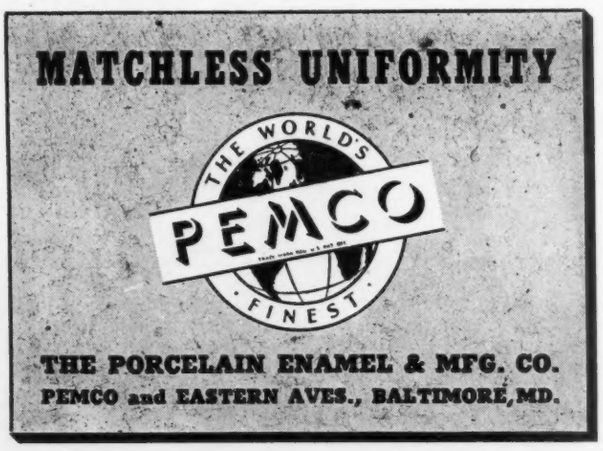
**Congress Tool & Die Co., 9020 Lumpkin Ave., Detroit, Mich.**

Dick, R. & J. Co., Inc., Passaic, N. J.

Dodge Mfg. Co., Mishawaka, Ind.

Franklin Machine Co., 44 Cross, Providence, R. I.

Hill Clutch Machine & Foundry Co., Cleveland, Ohio




***For further information on companies listed***

Hoe, R., & Co., Inc., 910 E. 138th, New York

**Link-Belt Co., 307 N. Michigan Ave., Chicago.**

Medart, Co., The, 3500 DeKalb, St. Louis, Mo.

Penney & Sons Co., Mechanic Falls, Maine

Royersford Foundry & Machine Co., Royersford, Pa.

Smith, Winfield H., Inc., Springville, Erie Co., N. Y.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sumner Iron Wks., Everett, Wash.

Western Gear Works, Seattle, Wash.

Wood's T. B., Sons Co., Chambersburg, Pa.

Watson-Flagg Machine Co., Paterson, N. J.

### PULLEYS, V-BELT

**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**

American Casting Co., 2140 Freeman Ave., Cincinnati, Ohio

**Boston Gear Works, Inc., North Quincy Mass.**

Chicago Belting Co., 117 N. Green, Chicago

**Congress Tool & Die Co., 9020 Lumpkin Ave., Detroit, Mich.**

Dodge Mfg. Co., Mishawaka, Ind.

Dayton Rubber Mfg. Co., Dayton, Ohio.

Dick, R. & J., Co., Inc., Passaic, N. J.

Equipment Engineering Co., Minneapolis, Minn.

Gates Rubber Co., 999 S. Broadway, Denver, Colo.

Goodrich, B. F., Co., 522 S. Main, Akron, Ohio

Hill Clutch Machine & Foundry Co., Cleveland, Ohio

Hoe, R., & Co., Inc., 910 E. 138th, New York

Lansing Stamping Co., Lansing, Mich.

Medart Co., The, 3500 DeKalb, St. Louis, Mo.

New Products Corp., Benton Harbor, Mich.

Smith, Winfield H., Inc., Springfield, Erie Co., N. Y.

Sumner Iron Wks., Everett, Wash.

Watson-Flag Machine Co., Paterson, N. J.

Western Gear Works, Seattle, Wash.

Wood's T. B., Sons Co., Chambersburg, Pa.

Worthington Pump & Machy. Corp., Harrison, N. J.

### PUMPS, GEAR TYPE, HYDRAULIC

*Used to actuate machine elements*

American Engineering Co., 2501 Aramingo Ave., Philadelphia, Pa.

Barnes, J. S., Corp., Rockford, Ill.

**Brown & Sharpe Mfg. Co., Providence, R. I.**

**De Laval Steam Turbine Co., Trenton, N. J.**

Farrell-Birmingham Co., Inc., 344 Vulcan. Buffalo, N. Y.

Garner-Denver Co., Quincy, Ill.

Gerotor May Co., Baltimore, Md. Gilead, Ohio

Hydraulic Press Mfg. Co., Mt. Gilead, Orio

Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.

Kinney Mfg. Co., 3529 Washington, Boston, Mass.

Kraissl Co., Inc., Hackensack, N. J.

Nichols, W. H., Waltham, Mass.

Northern Pump Co., Minneapolis, Minn.

**Racine Tool & Machine Co., 1772 State, Racine, Wis.**

Rockford Drilling Machine Co., Rockford, Ill.

**Roper Corp., Geo. D., Rockford, Ill.**

Sundstrand Machine Tool Co., Rockford, Ill.

**Tuthill Pump Co., 949 E. 95th St., Chicago**

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

Viking Pump Co., Cedar Falls, Iowa

Worthington Pump & Machy. Corp., Harrison, N. J.

### PUMPS, ROTARY VANE, HYDRAULIC

*Used to actuate machine elements*

American Engineering Co., 2501 Aramingo Ave., Philadelphia, Pa.

**Brown & Sharpe Mfg. Co., Providence, R. I.**

**De Lavel Steam Turbine Co., Trenton, N. J.**

Gardner-Denver Co., Quincy, Ill.

Kinney Mfg. Co., 3529 Washington, Boston, Mass.

Kraissl Co., Inc., Hackensack, N. J.

Micro-Westco, Inc., Bettendorf, Iowa

Pettibone Mulliken Corp., 4710 W. Division, Chicago

**Racine Tool & Machine Co., 1772 State, Racine, Wis.**

Thompson Products Inc., Cleveland, Ohio

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

Worthington Pump & Machy Corp., Harrison, N. J.

*in bold face type, see index on last page*


*The Swing*

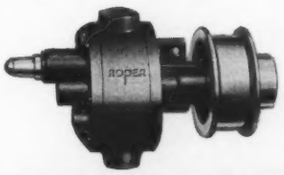
is to

ROPER

*Coolant*

PUMPS

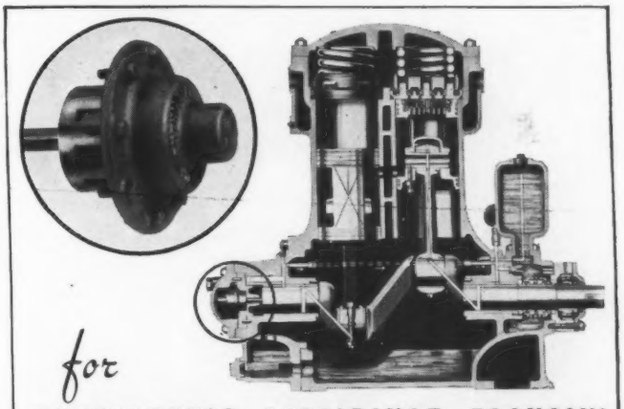
REASON . . . they do one whale of a job wherever they are put to work. Roper Coolant Pumps have the punch to reach the deepest cuts and bores and they are engineered to give extra long service. Made in practically all types needed for handling cutting compounds and lubricating fluids on metal working machines.



*Write for*

Bulletin R4PE

GEO. D. ROPER CORP., ROCKFORD, ILL.



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COMPACTNESS, APPEARANCE, ECONOMY BUILD THE LUBRICATING PUMP INTO YOUR MACHINE . . .

Tuthill supplies "Stripped" pumps to builders of machinery for direct incorporation into their designs where compactness, appearance and economy are of primary importance. These pumps are available in capacities up to 50 g. p. m. including the well-known Tuthill automatic reversing pump illustrated above. Series "S" provides pumps without the supporting bracket. Series "SA" includes only the rotor, idler and cover assembly for even greater compactness as shown above. *Write for complete details.*

TUTHILL PUMP COMPANY

949 EAST 95th STREET CHICAGO, ILLINOIS

for Flexibility and Economy

. . . use Rotary Geared MOTORPUMPS

— flexible in installation
— save expensive power take-off

3 sizes—Nos. 101-102-103
Brown & Sharpe Mfg. Co.,
Providence, R. I., U. S. A.

BROWN & SHARPE PUMPS

B·S

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VARIABLE VOLUME HYDRAULIC PUMPS

Extremely quiet, smooth performance. A thoroughly proven, efficient pump for pressures up to 1000 lbs. per sq. inch. Capacities 2000 - 4000 - 6000 cubic inches per minute.
The Variable Volume feature saves horse-power. Delivers amount of oil actually required. Volume is controlled automatically or manually.

*Write for catalog P-10.*

**RACINE HYDRAULIC VALVES**

A complete line—manual—pilot or electrically operated. Balanced pistons — Accurately fitted. For oil-hydraulic installations.

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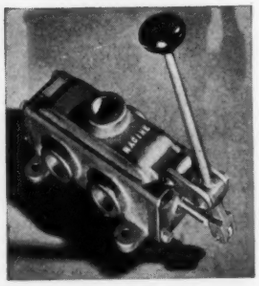

RACINE TOOL & MACHINE COMPANY
1772 STATE ST. RACINE, WISCONSIN

**PUMPS, HYDRAULIC**
*Multiple Cylinder and Piston (radial, wabble plate, or wash plate.) Used to actuate machine elements*

American Engineering Co., 2501 Aramingo Ave., Philadelphia, Pa.
Barnes, J. S., Corp., Rockford, Ill.
Gardner-Denver Co., Quincy, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Northern Pump Co., Minneapolis, Minn.
Oilgear Corp., Milwaukee, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.
Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.
Waterbury Tool Co., Waterbury, Conn.

**PUMPS, VACUUM**
*For use in packaging, bottling, feeding, impregnating, and gas exhausting operations*

**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**
Beach-Russ Co., 50 Church, New York
Buffalo Foundry & Machine Co., Buffalo, N. Y.
Columbus Steam Pump Works Co., Columbus, Ohio
Gardner-Denver Co., Quincy, Ill.
Gerotor May Co., Baltimore, Md.
Ingersoll-Rand Co., 11 Broadway, New York
International Machine Works, North Bergen, N. J.
Kinney Mfg. Co., 3529 Washington, Boston, Mass.
Kraissl Co., Inc., Hackensack, N. J.
Leiman Bros., Inc., Newark, N. J.
Nichols, W. H., Waltham, Mass.
Pennsylvania Pump & Compressor Co., Easton, Pa.
**Stokes Machine Co., Philadelphia, Pa.**
Sullivan Machinery Co., Michigan City, Ind.
Worthington Pump & Machy. Corp., Harrison, N. J.

**RECTIFIERS**
*Metallic, dry rectifiers with no moving parts for changing a. c. to d. c.*

B-L Electric Mfg. Co., 1832 Washinton Blvd., St. Louis, Mo.
**General Electric Co., Schenectady, N. Y.**
Mallory, P. R., & Co., Inc., Indianapolic, Ind.
Western Electric Co., 195 Broadway, New York
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., Newark, N. J.
Union Switch & Signal Co., Swissvale, Pa.

**REELS, PAY-OUT & TAKE-UP For electric cord**

Appleton Electric Co., 1740 Wellington Ave., Chicago
Hayward Co., 50 Church, New York
Vacuum Cleaner Corp. of America, Wissahickon Ave., Philadelphia, Pa.

**RELAYS**

Allen-Bradley Co., Milwaukee, Wis.
**American Automatic Electric Sales Co., 1033 W. Van Buren, Chicago**
Arrow-Hart & Hageman Electric Co., Hartford, Conn.
Automatic Reclosing Circuit Breaker Co., Columbus, Ohio
Automatic Temperature Control Co., Philadelphia, Pa.
Bendix Marine Products Co., 754 Lexington Ave., Brooklyn, N. Y.
Clark Controller Co., Cleveland, Ohio
Condit Electrical Mfg. Corp., Hyde Park, Boston, Mass.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
**Dunn, Struthers, Inc., Philadelphia, Pa.**
Eagle Signal Corp., Moline, Ill.
Edison, Thomas A., Inc., Orange, N. J.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Friez, Julien P., & Sons, Inc., Baltimore, Md.
G-M Laboratories, Inc., 1731 Belmont Ave., Chicago
Gamewell Co., Newton Upper Falls, Mass.
**General Electric Co., Schenectady, N. Y.**
**Guardian Electric Mfg. Co., 1629 W. Walnut, Chicago**
Hart Mfg. Co., Hartford, Conn.
McCorkle, D. H., Co., Berkeley, Calif.
Mercoid Corp., 4203 Belmont Ave., Chicago
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Des Moines, Iowa
Perfex Controls Co., Milwaukee, Wis.
Rawson Electrical Instrument Co., 110 Potter, Cambridge, Mass.

*For further information on companies listed*

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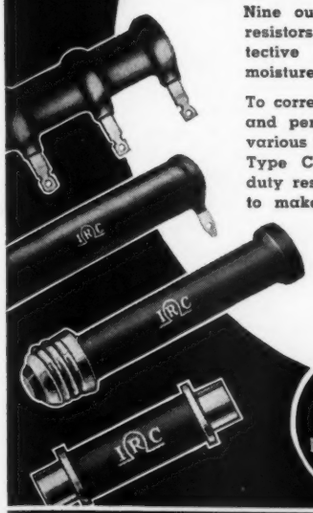
**TROUBLE-FREE RESISTORS**

Nine out of ten breakdowns in ordinary resistors are caused by failure of the protective covering, either in keeping out moisture, or in dissipating heat.

To correct this condition, IRC has pioneered and perfected BOTH molded insulation for various small resistor types and the famous Type C Cement Coating for large, heavy duty resistors. By whatever test you choose to make, you will find these unique IRC protective coatings supreme. They are the secret of real resistance durability.



IRC

REG. U.S. PAT. OFF.

Initiative — Resourcefulness — Cooperation to advance the interests of the industry

**INTERNATIONAL RESISTANCE COMPANY**

423 NORTH BROAD STREET, PHILADELPHIA

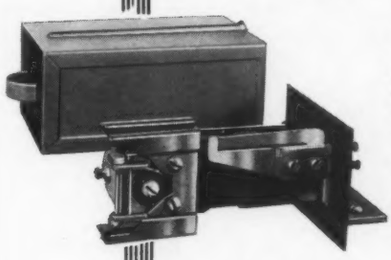
Factories or Licensees in Canada, England, France, Germany, Italy, Denmark and Australia

MAKERS OF RESISTANCE UNITS OF MORE TYPES, IN MORE SHAPES, FOR MORE APPLICATIONS THAN ANY OTHER MANUFACTURER IN THE WORLD



**RELAYS**

**FOR ANY INDUSTRIAL REQUIREMENT**



●Series AQA Relay equipped with Mounting Bracket, Cover Guide, and Cover. A standard model for general uses where requirements call for rapid switching of one or more circuits.

●The Automatic Electric line of relays includes quick and delayed action types, sensitive and heavy duty types, mechanical locking types, polarized relays, etc. Available with any contact combination and for operation on D. C. or A. C. circuits of any voltage.

Write for complete illustrated catalog of relays, stepping switches, electric counters, solenoids, keys, and other electrical control accessories. Address American Automatic Electric Sales Company, 1033 W. Van Buren St., Chicago.

**AUTOMATIC ELECTRIC**

**CONTROL AND SIGNALING EQUIPMENT**


Roller-Smith Co., 233 Broadway, New York
Rowan Controller Co., Baltimore, Md.
Russell Electric Co., 340 West Huron, Chicago
Signal Engineering & Mfg. Co., 152 W. 14th, New York
**Square D Co., Milwaukee, Wis.**
States Co., 19 New Park Ave., Hartford, Conn.
Trumbull Electric Mfg. Co., Plainville, Conn.
Ward Leonard Electric Co., Mount Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.
Weston Electrical Instrument Corp., Newark, N. J.
White-Rodgers Electric Co., St. Louis, Mo.

### RESISTORS

Acme Electric Heating Co., 1217 Washington, Boston, Mass.
Carborundum Co., Niagara Falls, N. Y.
Clark Controller Co., 1146 E. 152d, Cleveland, Ohio
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
**General Electric Co., Schenectady, N. Y.**
General Radio Co., 30 State, Cambridge, Mass.
Hardwick, Hindle, Inc., 40 Herman, Newark, N. J.
**Internatonal Resistance Corp., 423 N. Broad, Philadelphia, Pa.**
Mallory, P. R., & Co., Inc., Indianapolis, Ind.
Monitor Controller Co., Baltimore, Md.
National Electric Controller Co., 5307 Ravenswood, Chicago
Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York
Triplett Electrical Instrument Co., Buffton, Ohio
Ward Leonard Electric Co., Mount Vernon, N. Y.
Warren Electric Appliance Co., Warren, Pa.
Weston Electrical Instrument Corp., Newark, N. J.

### RHEOSTATS

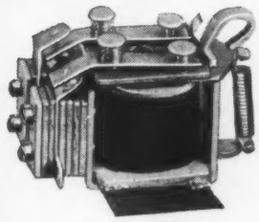
*Resistance rheostats such as used for speed control of d.c. motors*

Acme Electric Heating Co., 1217 Washington, Boston, Mass.

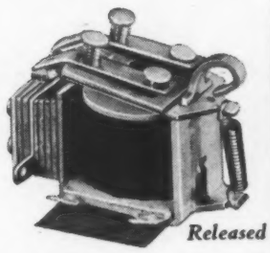
*in bold face type, see index on last page*


*Never Before a Small Relay with Features Like Guardian's*

**NEW 150 AC 155 DC RELAY**



*Attract Position*



*Released*

OFFERS advantages never before found on a small relay. Self seating spring tension contacts never change tension . . . almost never affected by vibration . . . need no adjustment. Will *not* open from jar or vibration. Contacts have full double-wiping action, either "attract" or "released". Full floating armature cannot stick in any position. Noiseless operation. Choice of several types of mounting brackets or can be mounted with one screw. Has *closed field* for maximum distribution and utilization of lines of magnetic force. Ready accessibility. Easy Wiring. Current drain approx. 2 watts. Pure Silver Contact points.

★ *WRITE today for details and FREE CATALOG "P" showing entire line of relays, stepping switches, solenoids, electric counters, mercury switches and other control accessories.*

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1629 W. Walnut St. Chicago • Illinois

**RHEOSTATS (Cont.)**

Allen-Bradley Co., Milwaukee, Wis.

Biddle, J. G., Co., 1211 Arch, Philadelphia, Pa.

Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio

Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago

**General Electric Co., Schenectady, N. Y.**

General Radio Co., 30 State, Cambridge, Mass.

G-M Laboratories, Inc., 1735 Belmont Ave., Chicago

Hardwick & Hindle, Inc., Newark, N. J.

Mallory, P. R., & Co., Inc., Indianapolis, Ind.

Monitor Controller Co., Baltimore, Md.

National Electric Controller Co., 5307 Ravenswood Ave., Chicago

Ohmite Mfg. Co., 4835 W. Flournoy, Chicago

Udylite Co., 1651 E. Grand Blvd., Detroit, Mich.

Ward Leonard Electric Co., Mount Vernon, N. Y.

Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

**RHODIUM**

*Alloys and Compounds*

American Platinum Works, N.J.R.R. Ave. at Oliver St., Newark, N. J.

Baker & Co., Inc., Newark, N. J.

Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.

Bishop, J., & Co. Platinum Works, 12 Channing Ave., Malvern, Pa.

Goldsmith Bros. Smelting & Refining Co., E. Washington, Chicago

Johnson & Mathey Co., Inc., 15 W. 47th, New York

**RIVETS, BRASS AND COPPER**

*Solid, bifurcated or split, and tubular types. These manufacturers also make washers or burrs.*

**American Brass Co., Waterbury, Conn.**

Atlas Bolt & Screw Co., Cleveland, Ohio

Bayonne Bolt Corp., Bayonne, N. J.

Blake & Johnson Co., Waterville, Conn.

Buffalo Bolt Co., North Tonawanda, N. Y.

Central Screw Co., 3501 Shields Ave., Chicago

Chase Brass & Copper Co., Waterbury, Conn.

Chicago Rivet & Machine Co., 1830 S. 54th Ave., Chicago

Clark Bros. Bolt Co., Milldale, Conn.

Conklin, T. E., Brass & Copper Co., 56 Lafayette, New York

**Continental Screw Co., New Bedford, Mass.**

Crescent Belt Fastener Co., 247 Park Ave., New York

Elco Tool & Screw Corp., Rockford, Ill.

Harper, H. M., Co., 2620 Fletcher St., Chicago

**Hassall, John, Inc., 400 Oakland St., Brooklyn, N. Y.** (Nails, rivets and screws to order)

Milford Rivet & Machine Co., Milford, Conn.

**National Screw & Mfg. Co., Cleveland, Ohio**

Pheoll Mfg. Co., Roosevelt Road, Chicago

Plume & Atwood Mfg. Co., Waterbury, Conn.

Revere Copper & Brass, Inc., 230 Park Ave., New York

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

**Scovill Mfg. Co., Waterbury, Conn.**

Sessions, J. H., & Son, Bristol, Conn.

Stimpson, Edwin B., Co., 92 Franklin Ave., Brooklyn

**RIVETS, IRON AND STEEL**

Atlas Bolt & Screw Co., 1130 Ivanhoe Rd., Cleveland, Ohio

Automatic Nut Co., Lebanon, Pa.

Bayonne Bolt Corp., Bayonne, N. J.

Bethlehem Steel Co., Bethlehem, Pa.

Blake & Johnson Co., Waterville, Conn.

Bridgeport Screw Co., Bridgeport, Conn.

Byers, A. M., Co., Pittsburgh, Pa. (Wrought iron)

Central Screw Co., 3501 Shields Ave., Chicago

Chicago Rivet & Machine Co., 1830 S. 54th Ave., Chicago

Clark Bros. Bolt Co., Milldale, Conn.

Crescent Belt Fastener Co., 247 Park Ave., New York

Elco Tool & Screw Corp., Rockford, Ill.

**Hassall, John, Inc., 400 Oakland, Brooklyn, N. Y.** (Nails, rivets and screws to order)

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

National Screw & Mfg. Co., Cleveland, Ohio

Neeley Nut & Bolt Co., Pittsburgh, Pa.

Oliver Iron & Steel Corp., Pittsburgh, Pa.

Pheoll Mfg. Co., Roosevelt Rd, Chicago

Pittsburgh Screw & Bolt Corp., Pittsburgh, Pa.

Reed & Prince Mfg. Co., Worcester, Mass.

Republic Steel Corp., Cleveland, Ohio

Robertson, W. F., Steel & Iron Co., Cincinnati, Ohio

Rockford Bolt & Steel Co., Rockford, Ill.

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

Ryerson, Joseph T. & Son, Inc., Buffalo, N. Y.

Scully Steel Products Co., 1319 Wabanasia Ave., Chicago

Sessions, J. H., & Sons, Bristol, Conn.

Stimpson, Edwin B., Co., 92 Franklin Ave., Brooklyn, N. Y.

Townsend Co., New Brighton, Pa.

Ulster Iron Works, Dover, N. J.

**RUBBER**

*Sheets, tube and bulk*

American Hard Rubber Co., 11 Mercer, New York

Cincinnati Rubber Mfg. Co., Cincinnati, Ohio

Continental Rubber Works, 1902 Liberty, Erie, Pa.

Corduroy Rubber Co., Grand Rapids, Mich.

Firestone Tire & Rubber Co., Akron, Ohio

Gates Rubber Co., 999 S. Broadway, Denver, Colo.

Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.

Goodrich, B. F., Co., 522 S. Main, Akron, Ohio

Goodyear Tire & Rubber Co., Akron, Ohio

New York Belting & Packing Co., Passaic, N. J.

Peerless Rubber Co., 4127 W. Kinzie, Chicago

Quaker City Rubber Co., Philadelphia, Pa.

Republic Rubber Div., Lee Rubber & Tire Corporation, Youngstown, Ohio

Sponge Rubber Products Co., Derby, Conn. (sponge rubber)

Stokes, Jos., Rubber Co., Trenton, N. J.

Thermoid Rubber Co., Trenton, N. J.

U. S. Rubber Products, Inc., 1790 Broadway, New York

Western Rubber Co., Goshen, Ind.

**RUBBER, MOLDED PARTS**

American Hard Rubber Co., 11 Mercer, New York


**SOURCES OF SUPPLY**

. . . as listed in this section, are based on previous **Product Engineering** Directories **plus** information received during the last six weeks in reply to more than 2,200 questionnaires sent out by our editors. Listings were made as complete as possible. However, if there's something you can't find just drop us a line.

**PRODUCT ENGINEERING**

**330 W. 42nd St., New York, N. Y.**


***For further information on companies listed***

Cincinnati Rubber Mfg. Co., Cincinnati, Ohio
Continental Rubber Works, 1902 Liberty, Erie, Pa.
Corduroy Rubber Co., Grand Rapids, Mich.
Dayton Rubber Mfg. Co., Dayton, Ohio
Firestone Tire & Rubber Co., Akron, Ohio
**Garlock Packing Co., Palmyra, N. Y.**
Gates Rubber Co., 999 S. Broadway, Denver, Colo.
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gordon Mfg. Co., 110 E. 23rd, New York
New York Belting & Packing Co., Passaic, N. J.
Ohio Rubber Co., Willoughby, Ohio
Quaker City Rubber Co., Philadelphia, Pa.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio
**Richardson Co., Lockland, Cincinnati, Ohio**
Stokes Rubber Co., Trenton, N. J.
U. S. Rubber Co., 1790 Broadway, New York
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago
Western Rubber Co., Goshen, Ind.

### RUBBER, SPONGE

Corduroy Rubber Co., Grand Rapids, Mich.
Sponge Rubber Products Co., Derby, Conn.

### RUBBER, SYNTHETIC

Armstrong Cork Products Co., Lancaster, Pa.
Chemnyco Co., 521 Fifth Ave., New York
Continental Rubber Works, 1902 Liberty, Erie, Pa.
Corduroy Rubber Co., Grand Rapids, Mich.
**Du Pont de Nemours & Co., Inc., Wilmington, Del.**
Firestone Tire & Rubber Co., Akron, Ohio
**Garlock Packing Co., Palmyra, N. Y.**
Gates Rubber Co., 999 S. Broadway, Denver, Colo.
Goodall Rubber Co., 5 S. 36th, Philadelphia, Pa.
Goodrich, B. F., Co., 522 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
New York Belting & Packing Co., Passaic, N. J.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, Ohio
Thermoid Rubber Co., Trenton, N. J.
**Thiokol Corp., Yardville, N. J.**
U. S. Rubber Products, Inc., 1790 Broadway, New York
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago
Western Rubber Co., Goshen, Ind.

### RUST PROOFING, CHEMIICAL PROCESSES

Alrose Chemical Co., Providence, R. I.
American Chemical Paint Co., Ambler, Pa.
Bridgeport Chain & Mfg. Co., Bridgeport, Conn.
Parker Rust-Proof Co., Detroit, Mich.
Berry Brothers, 211 Leib, Detroit, Mich.
**E. I. DuPont de Nemours & Co., Inc., Wilmington, Del.**
Udylite Co., 1651 E. Grand Blvd., Detroit, Mich.

### SCREENS, ELECTRO DEPOSITED

*Extremely fine mesh, smooth surface screening made by electro-deposition. (see also Wire Cloth, Woven)*
Gilbert & Bennett Mfg. Co., Georgetown, Conn.
Jelliff Mfg. Corp., Southport, Conn.

### SCREENS, WOVEN WIRE

Ajax Flexible Coupling Co., Weatfield, N. Y.
Audubon Wire Cloth Co., Audubon, N. J.
Belleville Wire Cloth Co., Inc., 135 Little, Belleville, N. J.
Cleveland Wire Cloth & Mfg. Co., 3573 E. 78th, Cleveland, Ohio
Cole-Roscoe Mfg. Co., Bates Court, S. Norwalk, Conn.
Cross Engineering Co., Carbondale, Pa.
Gilbert & Bennett Mfg. Co., Georgetown, Conn.
Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.
Ludlow-Saylor Wire Co., St. Louis, Mo.
Newark Wire Cloth Co., 351 Berona Ave., Newark, N. J.
Phoenix Wire Wks., 1940 E. Kirby Ave., Detroit, Mich.
Roebling's, J. A., Sons Co., Trenton, N. J.
Seneca Wire & Mfg. Co., Fostoria, Ohio
Taylor-Wharton Iron & Steel Co., High Bridge, N. J. (manganese steel)
United Metals, 620 Hamilton, Spokane, Wash.
Wickwire Spencer Steel Co., 41 E. 42nd, New York

### SCREWS, PHILLIPS, RECESSED HEAD

*Wood machine and sheet metal screws and stove bolts with patented recessed heads*
**American Screw Co., Providence, R. I.**
**Continental Screw Co., New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
**National Screw & Mfg. Co., 2446 E. 75th, Cleveland, Ohio**
**Parker-Kalon Corp., 196 Varick, New York**
Reading Screw Co., Norristown, Pa.

### SCREW MACHINE PRODUCTS

**Alumnium Co. of America, 2193 Gulf Bldg., Pittsburgh, Pa. (Alumnium)**
Ansonia Mfg. Co., Ansonia, Conn.
**Barnes, Wallace, Co., Bristol, Conn.**
Blake & Johnson Co., Waterville, Conn.
Bowen Products Corp., Canal St., Auburn, N. Y.
Brighton Screw & Mfg Co., 1456 Harrison Ave., Cincinnati, Ohio
Burgess-Parr Co., Freeport, Ill.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Chicago Electric Mfg. Co., 6333 W. 65th, Chicago
Chicago Screw Co., 1026 S. Homan Ave., Chicago
**Corbin Screw Corp., New Britain, Conn.**
Detroit Screw Works, Detroit, Mich.
Dole Valve Co., 1901-41 Carroll Ave., Chicago
Eastern Machine Screw Co., New Haven, Conn.
Faries Mfg. Co., Decatur, Ill.
Federal Screw Works, Detroit, Mich.
Foster Machine Co., Elkhart, Ind.
Franklin Machine Co., 44 Cross, Providence, R. I.
Franklin Fibre-Lamitex Corp., Wilmington, Del. (Bakelite and fibre)
Greist Mfg. Co., New Haven, Conn.
Harper, H. M., Co., 2620 Fletcher, Chicago
Hartford Machine Screw Co., Hartford, Conn.
**Hassall, John, Inc., 400 Oakland, Brooklyn, N. Y.** (Nails, rivets and screws to order)
Hoe, R., & Co., Inc., 910 E. 138th, New York
**Hunter Pressed Steel Co., Lansdale, Pa.**
Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago
**Lamson & Sessions Co., Cleveland, Ohio**
**Link-Belt Co., 307 N. Michigan Ave., Chicago**
Mac-it Parts Co., Lancaster, Pa.
Milwaukee Stamping Co., Milwaukee, Wis.
Mueller Brass Co., Port Huron, Mich.
National Acme Co., Cleveland, Ohio
National Brass Co., Grand Rapids, Mich.
National Gauge Corp., 300 Pacific, Brooklyn, N. Y.
**National Screw & Mfg. Co., Cleveland, Ohio**
New Britain Machine Co., New Britain, Conn.
Ottenmiller Co., York, Pa.
**Peck Spring Co., The, Plainville, Conn.**
Plume & Atwood Mfg. Co., Waterbury, Conn.
Remler Co., Ltd., San Francisco, Calif.
Revere Copper & Brass, Inc., Rome, N. Y.
Rochester Machine Screw Co., Rochester, N. Y.
Royersford Foundry & Machine Co., Royersford, Pa.
St. Louis Screw & Bolt Co., St. Louis, Mo.
**Scovill Mfg. Co., Waterbury, Conn.**
**Standard Pressed Steel Co., Jenkintown, Pa**
Strong Carlisle & Hammond Co., Cleveland, Ohio
**Torrington Co., Torrington, Conn.**
Turner & Seymour Mfg. Co., Torrington, Conn.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Waltham Watch Co., Waltham, Mass.
Weatherhead Co., Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio

### SCREWS, DRIVE

*Having long spiral lead and driven with hammer*
**American Screw Co., Providence, R. I.**
**Continental Screw Co., New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
Elco Tool & Screw Corp., Rockford, Ill.
Franklin Machine Co., 44 Cross, Providence, R. I.
**Hassall, John, Inc., 400 Oakland, Brooklyn, N. Y.** (Nails, rivets and screws to order)
Hillwood Mfg. Co., 21700 St. Clair Ave., Cleveland, Ohio
**National Screw & Mfg. Co., Cleveland, Ohio**

*in bold face type, see index on last page*

**SCREWS, DRIVE (Contd)**

**Parker-Kalon Corp., 200 Varick St., New York (Hardened)**
Rawlplug Co., Inc., 98 Lafayette, New York
Reading Screw Co., Norristown, Pa.
Reed & Prince Mfg. Co., Worcester, Mass.
Republic Steel Corp., Cleveland, Ohio

**SCREWS, HOLLOW OR SOCKET HEAD**

*Hardened fillister and headless screws*

**Allen Mfg. Co., Hartford, Conn.**
**American Screw Co., Providence, R. I.**
Brighton Screw & Mfg. Co., Cincinnati, Ohio
Bristol Co., Waterbury, Conn.
Chicago Screw Co., 1026 S. Homan Ave., Chicago, Ill.
Columbia Nut & Bolt Co., Bridgeport, Conn.
**Continental Screw Co., 459 Mt. Pleasant St., New Bedford, Mass.**
Dardalet Threadlock Corp., 55 Liberty, New York
Detroit Screw Works, Detroit, Mich.
Grip Nut Co., 5915 S. Western Blvd., Chicago
Hartford Machine Screw Co., Hartford, Conn.
**Holo-Krome Screw Corp., Hartford, Conn.**
**Lamson & Sessions Co., Cleveland, Ohio**
Mac-it Parts Co., Lancaster, Pa.
**Parker-Kalon Corp., 200 Varick, New York**
Pheoll Mfg. Co., 5700 Roosevelt Rd., Chicago
St. Louis Screw & Bolt Co., St. Louis, Mo.
**Standard Pressed Steel Co., (Box 545) Jenkintown, Pa.**
Strong, Carlisle & Hammond Co., Cleveland, Ohio
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Western Automatic Machine Screw Co., Elyria, Ohio

**SCREWS, SELF-TAPPING**

*Hardened screws with standard machine screw threads and applied with screw driver without tapping the hole*

**American Screw Co., Providence, R. I.**
Central Screw Co., 3501 Shields Ave., Chicago
**Continental Screw Co., 459 Mt. Pleasant St., New Bedford, Mass.**
**Corbin Screw Corp., New Britain, Conn.**
Elco Tool and Screw Corp., Rockford, Ill.
Groove-Pin Corp., 411 Kerrigan Ave., Union City, N. J.
Hartford Machine Screw Co., Hartford, Conn.
**Lamson & Sessions Co., Cleveland, Ohio**
**National Screw & Mfg. Co., Cleveland, Ohio**
**Parker-Kalon Corp., 200 Varick, New York**
Pheoll Mfg. Co., 5700 Roosevelt Rd., Chicago
Reading Screw Co., Norristown, Pa.
Shakeproof Lock Washer Co., 2525 N. Keeler Ave., Chicago

**SCREWS, THUMB**

**American Screw Co., Providence, R. I.**
Ansonia Mfg. Co., Ansonia, Conn.
Atlas Bolt & Screw Co., Cleveland, Ohio
Blake & Johnson Co., Waterville, Conn.
Billings & Spencer Co., 1 Laurel St., Hartford, Conn.
Brooks, M. S., & Sons, Chester, Conn.
Central Screw Co., 3501 Shields Ave., Chicago
Chicago Screw Co., 1026 S. Homan Ave., Chicago
Clark Bros. Bolt Co., Milldale, Conn.
Eberhard Mfg. Co., Cleveland, Ohio
Economy Screw Corp., 2707 Greenview Ave., Chicago
Elco Tool & Screw Corp., Rockford, Ill.
Harper, H. M., Co., 2620 Fletcher, Chicago
Hartford Machine Screw Co., Hartford, Conn.
Haskell, Wm. H., Mfg. Co., Providence, R. I.
**Lamson & Sessions Co., Cleveland, Ohio**
**National Lock Washer Co., Newark, N. J.**
**National Screw & Mfg. Co., Cleveland, Ohio**
**Parker-Kalon Corp., 200 Varick, New York**
Pheoll Mfg. Co., 5700 Roosevelt Rd., Chicago
Rochester Machine Screw Co., Rochester, N. Y.
St. Louis Screw & Bolt Co., St. Louis, Mo.
United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio
Washburn Co., Worcester, Mass.
Western Automatic Machine Screw Co., Elyria, Ohio
**Willliams, J. H., & Co., 400 Vulcan, Buffalo, N. Y.**
Wrightsville Hardware Co., Wrightsville, Pa.

***For further information on companies listed***

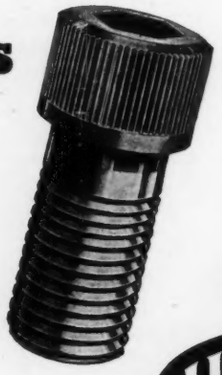
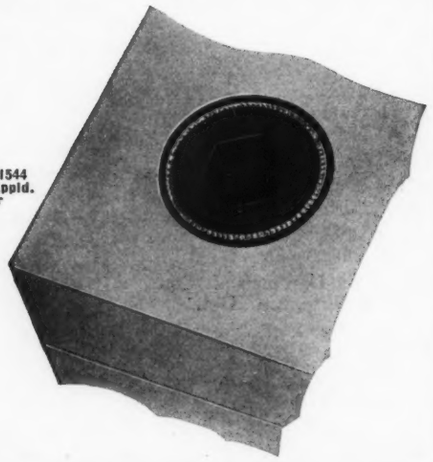

**This**  **plus This** **gives you This**

Fig. 1434 Pat's. Pending

**KNURLED**

**UNBRAKO**

Fig. 1544 Pat. appld. for



**SOCKET HEAD CAP SCREWS**
**can be locked (after countersinking) with the help of this simple tool**

*The Knurling does it—What others offer this advantage?*

With the Knurled "Unbrako" there are several ways it can be done . . . all very easy. They're all described in detail in our catalog, you should send for a copy.

**STANDARD PRESSED STEEL CO.**

BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. BOX 545 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

HAVE YOU SEEN AND SPECIFIED "UNBRAKO"
Self-Locking Hollow Set Screw

Where a set screw must not work loose use this. More than 2,000,000 in use attest its value. Send for sample.

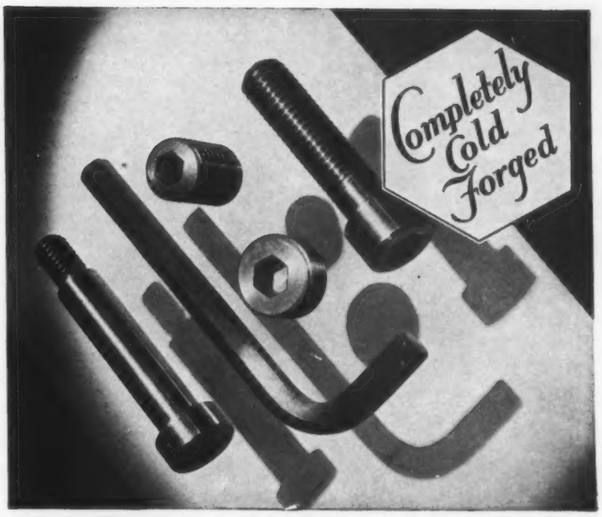
Fig. 1564 Pat. applied for

**SEALS, UNIT TYPE**
*For shafts or bearings.*
Armstrong Cork Products Co., Lancaster, Pa.
Bijur Lubricating Corp., Long Island City, N. Y.
Chicago Rawhide Mfg. Co., 1300 Elston Ave., Chicago
Felt Products Mfg. Co., 1504 Carroll Ave., Chicago
**Felters Co. Inc., 210 South, Boston, Mass.**
Firestone Tire & Rubber Co., Akron, Ohio
**Garlock Packing Co., Palmyra, N. Y.**
**Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago**
Michigan Leather Packing Co., Detroit, Mich.
National Motor Bearing Co., Oakland, Calif.
Preston Co., H. G., Detroit, Mich.
Universal Oil Seal Co., Pontiac, Mich.
Victor Gasket & Mfg. Co., 5750 W. Roosevelt Rd., Chicago
Western Felt Works, 4029 Ogden Ave., Chicago

**SHAFTING, FLEXIBLE**
*For fractional hp. drives and instruments*
Breeze Corp. Inc., Newark, N. J.
Dallett Co., Philadelphia, Pa.
Dumore Co., Inc., Racine, Wis.
Fischer Spring Co., 244 Kent Ave., Brooklyn, N. Y.
Jarvis, Chas. L., Co., Middletown, Conn.
Pratt & Whitney Co. Hartford, Conn.
Stewart Mfg. Co., 340 W. Huron, Chicago
Stow Mfg. Co. Inc., Binghamton, N. Y.
Swartz & White Mfg. Co., Binghamton, N. Y.
Thomas Flexible Shafting Co., Warren, Pa.
Waltham Watch Co., Waltham, Mass.
White Dental Mfg. Co., 10 E. 40th, New York
Young Spring & Wire Corp., Detroit, Mich.

**SHEAVES, V-BELT**
American Castings Co., 2140 Freeman Ave., Cincinnati, Ohio
Chicago Belting Co., 117 N. Green, Chicago
**Congress Tool & Die Co., 9020 Lumpkin Ave., Detroit**
Dodge Mfg. Corp., Mishawaka, Ind.
Dayton Rubber Mfg. Co., Dayton, Ohio

*in bold face type, see index on last page*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TRADE FIBRO FORGED MARK
Socket Screws
HOLO-KROME FIBRO FORGED TRADE MARK SCREWS
The results of a New and Better method of Socket Screw manufacturing—even the Socket within the Screw is completely cold forged—an exclusive Holo-Krome feature patented by
THE HOLO-KROME SCREW CORP. HARTFORD, CONN.

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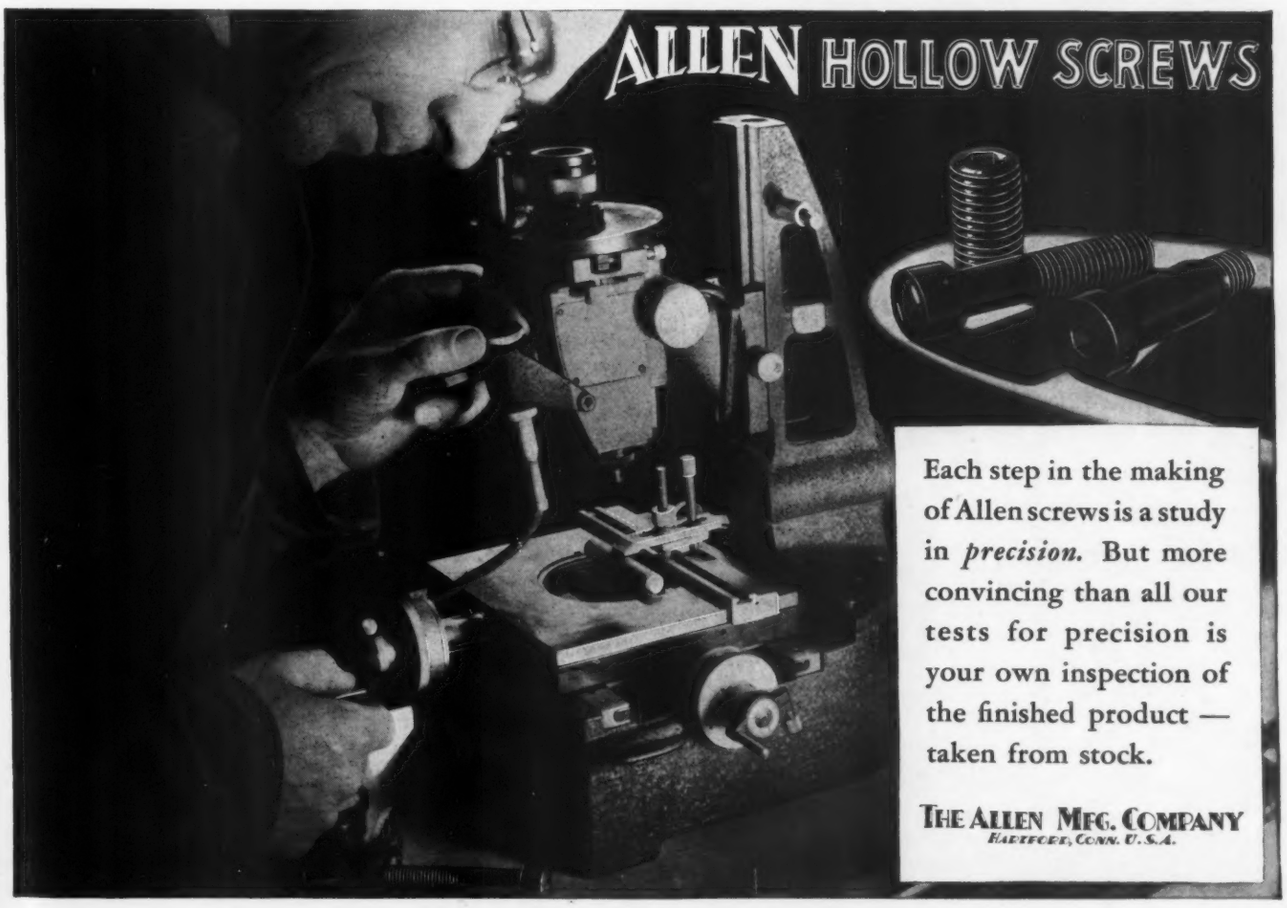
State style, size, etc. Write Sales Dept.




Each step in the making of Allen screws is a study in *precision.* But more convincing than all our tests for precision is your own inspection of the finished product — taken from stock.

THE ALLEN MFG. COMPANY
HARTFORD, CONN. U. S. A.

**SHEAVES, V-BELT (Contd)**

Dick, R. & J., Co., Inc., Passaic, N. J.

Gates Rubber Co., 999 S. Broadway, Denver, Colo.

Hill Clutch Machinery & Foundry Co., Cleveland, Ohio.

Hunter Machine Co., North Adams, Mass.

Medart Co., St. Louis, Mo.

Smith, Inc., Winfield H., Spring ville Erie Co., N. Y.

Sumner Iron Wks., Everett, Wash.

Western Gear Works, Seattle, Wash.

Wood's, T. B., Sons Co., Chambersburg, Pa.

Watson-Flagg Machine Co., Paterson, N. J.

Worthington Pump & Machinery Corp., Harrison, N. J.

**SHEETS, ALUMINUM**

**Aluminum Co. of America, 2193 Gulf Bldg., Pittsburgh, Pa.**

Nicralumin Co., Jackson, Mich.

**SHEETS, BRASS AND BRONZE**

**American Brass Co., Waterbury, Conn.**

**Ampco Metal, Inc., 3830 W. Burnham, Milwaukee, Wis.**

**Bridgeport Brass Co., Bridgeport, Conn.**

Miller Co., Meriden, Conn.

Plume & Atwood Mfg. Co., Waterbury, Conn.

Revere Copper & Brass Co., 230 Park Ave., New York

Riverside Metal Co., Riverside, N. J.

**Scovill Mfg. Co., Waterbury, Conn.**

Scully Steel Products Co., 1319 Wabanasia Ave., Chicago

Seymour Mfg. Co., Seymour, Conn.

Western Cartridge Co., East Alton, Ill.

**SHEETS, COPPER AND COPPER ALLOY**

**American Brass Co., Waterbury, Conn**

Berger Brothers Co., 229 Arch, Philadelphia, Pa.

**Bridgeport Brass Co., Bridgeport, Conn.**

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

Revere Copper & Brass Co., 230 Park Ave., New York

Riverside Metal Co., Riverside, N. J.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

**Scovill Mfg. Co., Waterbury, Conn.**

Scully Steel Products Co., 1319 Wabania Ave., Chicago

Seymour Mfg. Co., Seymour, Conn.

Western Cartridge Co., East Alton, Ill.

**SHEETS, COPPER-NICKEL**

**American Brass Co., Waterbury, Conn**

**General Plate Co., 40 Forest, Attleboro, Mass.**

Revere Copper & Brass Co., 230 Park Ave., New York

Riverside Metal Co., Riverside, N. J.

**Scovill Mfg. Co., Waterbury, Conn.**

Seymour Mfg. Co., Seymour, Conn.

Superior Metal Corp., Clearing, Ill.

**SHEETS, COPPER SILICON**

**American Brass Co., Waterbury, Conn.**

**Bridgeport Brass Co., Bridgeport, Conn.**

Revere Copper & Brass Co., 230 Park Ave., New York

**Scovill Mfg. Co., Waterbury, Conn.**

**SHEETS, GOLD**

American Platinum Works, N. J. R. R. Ave. at Oliver, Newark, N. J.

Baker & Co., Inc., 113 Astor St., Newark, N. J.

**General Plate Co., 40 Forest St., Attleboro, Mass.**

Goldsmith Bros., Smelting & Refining Co., 58 E. Washington, Chicago

Handy & Harman, 82 Fulton St., New York

**Wilson, H. A., Co., Newark, N. J.**

**SHEETS, MAGNESIUM ALLOY**

**Aluminum Co. of America, 2193 Gulf Bldg., Pittsburgh, Pa.**

American Magnesium Corp., 2210 Harvard Ave., Cleveland, Ohio

**Dow Chemical Co., Midland, Mich.**

**SHEETS, METAL, PERFORATED**

Cross Engineering Co., Carbondale, Pa.

**Erdle Perforating Co., 165 York, Rochester, N. Y.**

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

Kirk & Blum Mfg. Co., Cincinnati, Ohio

Nortmann-Duffke Co., Milwaukee, Wis.

Powell Pressed Steel Co., Hubbard, Ohio

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Wickwire Spencer Steel Co., 41 E. 42nd, New York

**SHEETS AND STRIP STEEL, BLUE ANNEALED**

Allegheny Steel Co., Brackenridge, Pa.

American Rolling Mills, Middletown, Ohio

Behlehem Steel Co., Bethlehem, Pa.

Bissett Steel Co., Cleveland, Ohio

**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**

Central Iron & Steel Co., Harrisburg, Pa.

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Crucible Steel Co. of America, 405 Lexington Ave., New York

Follansbee Brothers Co., Follansbee, W. Va.

Granite City Steel Co., Granite City, Ill.

Inland Steel Co., 38 S. Dearborn, Chicago

Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Lukens Steel Co., Coatesville, Pa.

Republic Steel Corp., Cleveland, Ohio

Roebling's, J. A., Sons Co., Trenton, N. J. (Strip only)

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Scully Steel Products Co., 1319 Wabania Ave., Chicago

Sharon Steel Corp., Sharon, Pa.

**U. S. Steel Corp., 71 Broadway, New York**

**SHEETS AND STRIP STEEL, COLD FINISHED**

Acme Steel Co., 2840 Archer Ave., Chicago

Allegheny Steel Co., Breckenridge, Pa.

American Rolling Mills, Middletown, Ohio

**American Steel & Wire Co., Cleveland, Ohio (strip only)**

Bethlehem Steel Co., Bethlehem, Pa.

Bissett Steel Co., Cleveland, Ohio

**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**

**Carpenter Steel Co., Reading, Pa.**

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Crucible Steel Co. of America, 405 Lexington Ave., New York

Follansbee Brothers Co., Follansbee, W. Va.

Griffin Mfg. Co., Erie, Pa.

Inland Steel Co., 38 S. Dearborn, Chicago

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PERFORATED METALS
A SUPERIOR ALL-PURPOSE PRODUCT
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Write for sample today.
ERDLE PERFORATING CO.
165 York Street
Rochester N. Y.

*For further information on companies listed*

Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Otis Steel Co., Cleveland, Ohio
Republic Steel Corp., Cleveland, Ohio
Roebling's John A., Sons Co., Trenton, N. J. (Strip only)
Ryerson, Joseph T., & Son, 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabania Ave., Chicago
Stanley Works, New Britain, Conn.
**Thomas Steel Co., The, Warren, Ohio**
Universal-Cyclops Steel Corp., Bridgeville, Pa.
**U. S. Steel Corp., 71 Broadway, New York**
Worcester Pressed Steel Co., Worcester, Mass.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Spencer Steel Co., 41 E. 42nd, New York (strip only)

**SHEETS AND STRIP, DEEP DRAWING**

Acme Steel Co., 2840 Archer Ave., Chicago
Allegheny Steel Co., Brecken-ridge, Pa.
American Rolling Mills, Middle-town, Ohio
**American Steel & Wire Co., Cleveland, Ohio (strip only)**
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
**Carpenter Steel Co., Reading, Pa.**
**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**
Crucible Steel Co. of America, 405 Lexington Ave., New York
Follansbee Brothers Co., Follansbee, W. Va.
Granite City Steel Co., Granite City, Ill.
Inland Steel Co., 38 S. Dearborn, Chicago
Jones & Laughlin Steel Corp., Pittsburg, Pa.
Otis Steel Co., Cleveland, Ohio
Republic Steel Corp., Cleveland, Ohio
Roebling's, John A., Sons Co., Trenton, N. J. (strip only)
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabania Ave., Chicago
Stanley Works, New Britain, Conn.
**Thomas Steel Co., The, Warren, Ohio**
**U. S. Steel Corp., 71 Broadway, New York**
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Wheeling Steel Corp., Wheeling, W. Va.

**SHEETS AND STRIP STEEL, GALVANIZED**

Acme Steel Co., 2840 Archer Ave., Chicago
Allegheny Steel Co., Brecken-ridge, Pa.
**American Steel & Wire Co., Cleveland, Ohio (strip only)**
American Rolling Mills, Middle-town, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Bissett Steel Co., Cleveland, Ohio
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**
Granite City Steel Co., Granite City, Ill. (strip only)
Inland Steel Co., 38 S. Dearborn, Chicago
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio
Roebling's, John A., Sons Co., Trenton, N. J. (strip only)
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
**Thomas Steel Co., The, Warren, Ohio**
**U. S. Steel Corp., 71 Broadway, New York**
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Spencer Steel Co., 41 E. 42nd, New York (strip only)

**SHEETS AND STRIP, NICKEL CLAD**

Apollo Metal Works, 6601 S. Oak Park Ave., Chicago
Bissett Steel Co., Cleveland, Ohio
**General Plate Co., 40 Forest, Attleboro, Mass.**
Ingersoll Steel & Disc Co., New Castle, Ind.
Superior Metal Corp., Clearing, Ill.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.

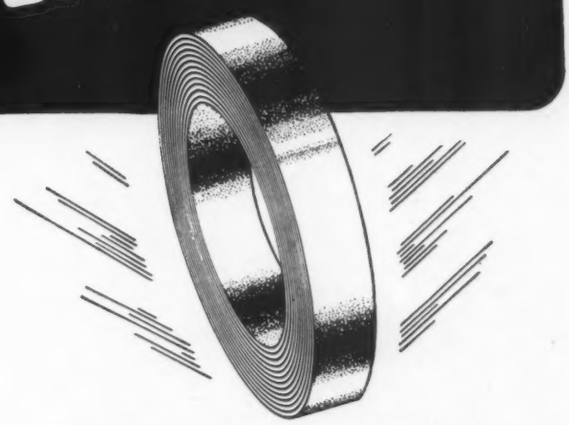
**SHEETS AND STRIP, PRE-FINISHED**

*Nickel, Tin, Zinc, or Copper Electroplated*

Acme Steel Co., 2840 Archer Ave., Chicago
American Nickeloid Co., Peru, Ill.
American Rolling Mills, Middle-town, Ohio

*in bold face type, see index on last page*


A COLD STRIP SERVICE THAT SPECIALIZES



. . . . specializes in giving you cold rolled strip when you want it, where you want it, and how you want it. Executive, sales, and engineering departments are all located AT THE MILL, thereby making possible a quick, sure, personalized answer to your cold strip problems. All departments are coordinated to constantly check deliveries, gauge, temper, and finishes, so that you may have the protection of Thomastrip uniformity.

In addition to meeting all specifications promptly, and accurately, The Thomas Steel Company produces electro finishes in zinc, copper, nickel, and brass, as well as uncoated bright finish. Investigate the possibility of using one of these finishes . . . investigate the advantages of a service that specializes in your cold strip requirements.

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COLD ROLLED STRIP STEEL
ZINC COATED • NICKEL COATED • COPPER COATED • BRASS COATED • BRIGHT FINISH UNCOATED

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Specialized Producers of Cold Rolled Strip Steel

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B·G·R VARIETIES OF 1938
FLAT TORSION SPRINGS
WIRE FORMS
COMPRESSION AND VALVE SPRINGS
SNAP RINGS
TORSION SPRINGS
DIE SPRINGS
EXTENSION SPRINGS
SPRING WASHERS
FLAT SPRINGS AND STAMPINGS
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NOW APPEARING IN IMPORTANT INDUSTRIAL CENTERS
If springs play a part in the performance of your product . . . send your specifications here and let us submit a proposal.
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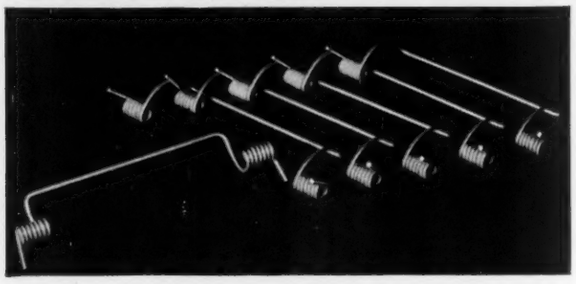
DETROIT PLANT DIVISION OF ASSOCIATED SPRING CORP. COOK PLANT
DETROIT, MICHIGAN ← TWO PLANTS → ANN ARBOR, MICHIGAN



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Springs for the Navy. Fabricated of highest grade music wire, to extremely close tolerances. Heat treated and cadmium plated; then treated again to remove gas that accumulates during plating. All our operations must pass Navy inspection; and on delivery the Navy makes chemical check on quality of wire and thickness of plating. A job exacting endless vigilance—but "Peck Service" is like that!

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An interesting book on spring technique and screw machine parts—valuable to designer, engineer and purchasing agent.

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The Peck Spring Co. 14 Summit St. Plainville, Conn.

**SHEETS AND STRIP, PREFINISHED**

Appollo Metal Works, 6601 S. Oak Park Ave., Chicago
Bissett Steel Co., Cleveland, Ohio
**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**
Inland Steel Co., First National Bank Bldg., Chicago
Superior Metal Corp., Clearing, Ill.
**Thomas Steel Co., The, Warren, Ohio**
**U. S. Steel Corp., 71 Broadway, New York**
Vanadium-Alloys Steel Co., Latrobe, Pa.

**SHEETS AND STRIP STEEL, STAINLESS**

Acme Steel Co., 2840 Archer Ave., Chicago, Ill.
Allegheny Steel Co., Brackenridge, Pa.
American Rolling Mill Co., Middletown, Ohio
Bethlehem Steel Corp., Bethlehem, Pa.
Ludlum Steel Co., Watervliet, N. Y.
Mitchell Steel Co., Stock Yards Sta., Cincinnati, Ohio
Republic Steel Corp., Cleveland, Ohio
Sharon Steel Corp., Sharon, Pa.
Simonds Saw & Steel Co., Lockport, N. Y.
**U. S. Steel Corp., 71 Broadway, New York**

**SHEETS AND STRIP, STAINLESS CLAD POLISHED**

Acme Steel Co., 2840 Archer Ave., Chicago
Bissett Steel Co., Cleveland, Ohio
**General Plate Co., 40 Forest Attleboro, Mass.**
Ingersoll Steel & Disc Co., New Castle, Ind.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Universal-Cyclops Steel Corp., Bridgeville, Pa.

**SHEETS AND STRIP, STAINLESS CLAD UNPOLISHED**

Acme Steel Co., 2840 Archer Ave., Chicago
Allegheny Steel Co., Breckenridge, Pa.
American Rolling Mills, Middletown, Ohio
Bissett Steel Co., Cleveland, Ohio
Crucible Steel Co. of America, 405 Lexington Ave., New York
Ingersoll Steel & Disc Co., New Castle, Ind.
Jessop Steel Co., Washington, Pa.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.
Scully Steel Products Co., 1319 Wabansia Ave., Chicago
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

**SHIMS**

**Laminated Shim Co., Inc., 21-26 44th Ave., Long Island City, N. Y.**
National Motor Bearing Co., Inc., Oakland, Calif.

**SHEET METAL PRODUCTS, DEEP DRAWN**

**American Brass Co., Waterbury, Conn.**
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
General Metal Products Co., 3883 Delor St., St. Louis, Mo.
Globe Machine & Stamping Co., Cleveland, Ohio
Lansing Stamping Co., Lansing, Mich.
Parish Pressed Steel Co., Reading, Pa.
Premier Metal Works, Inc., 1616 S. Clinton, Chicago
Revere Copper & Brass Co., 230 Park Ave., New York
Rockwood Sprinkler Co., Worcester, Mass.
**Scovill Mfg. Co., Waterbury, Conn.**
Seymour Mfg. Co., Seymour, Conn.
Western Cartridge Co., East Alton, Ill.

**SILVER**

*Sheet, Wire, Tubing*

American Platinum Works, N. J. R. R. Ave., at Oliver St., Newark, N. J.
Atkins, E. C., & Co., Indianapolis, Ind. (solder)
Baker & Co., 113 Astor, Newark, N. J.,
Belmont Smelting & Refining Works, Inc., Belmont Ave., Brooklyn, N. Y.
Chase Brass & Copper Co., Inc., Waterbury, Conn. (solder)
Disston, Henry, & Sons, Inc., Philadelphia (solder)
**General Plate Co., Attleboro, Mass. (sheet, tubing)**
Goldsmith Bros., Smelting & Refining Co., 58 E. Washington, Chicago (sheet, solder)

***For further information on companies listed***

Handy & Harman, 82 Fulton, New York (sheet, wire, solder)
Improved Seamless Wire Co., Providence, R. I. (sheet, wire, tubing)
Mallory, P. R., Co., Inc., Indianapolis, Ind. (elec. contacts)
Ney, J. M., Co., Hartford, Conn. (solder)
Noble, F. H. & Co., W. 59th, Chicago (solder)
Simonds Saw & Steel Co., Lockport N. Y. (solder)
Williams Gold Refining Co., Buffalo, N. Y. (sheet)
**Wilson, H. A., Co., Newark, N. J. (sheet)**

## SOCKETS, WIRE ROPE

*Made of forged steel wherein wire rope is flared and anchored*

**American Cable Co. Inc., Wilkes Barre, Pa.**
**American Steel & Wire Co., Cleveland, Ohio**
Broderick & Bascon Rope Co., St. Louis, Mo.
Chicago Steel Foundry Co., Kedzie Ave., Chicago
Laughlin, Thomas, Co., Portland, Me.
Leschen, A., & Sons Rope Co., St. Louis, Mo.
Macwhyte Co., Kenosha, Wis.
National Malleable & Steel Castings Co., Cleveland, Ohio
Roebling's, John A., Sons Co., Trenton, N. J.
Upson-Walton Co., Cleveland, Ohio
Wickwire Spencer Steel Co., 41 E. 42nd, New York
Wilcox, Crittenden & Co., Middleton, Conn.
**Williams, J. H., & Co., 400 Vulcan, Buffalo, N. Y.**
Williamsport Wire Rope Co., Williamsport, Pa.

## SOLDERS

*Silver, aluminum, tin-lead, etc.*

American Platinum Works, Newark, N. J.
Baker & Co., Inc., 60 Austin, Newark, N. J.
Belmont Smelting & Refining Works, 307 Belmont Ave., Brooklyn, N. Y.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
**General Plate Co., Attleboro, Mass.**
Handy & Harmon Co., 82 Fulton, New York
Simonds Saw & Steel Co., Fitchburg, Mass.
**Wilson, H. A., Co., 105 Chestnut, Newark, N. J.**

## SOLENOIDS

*For push-pull movements in a straight line*

Allen-Bradley Co., Milwaukee, Wis.
Anderson, C. J., & Co., 212 W. Hubbard, Chicago
Automatic Switch Co., 154 Grand, New York
Barber-Colman Co., Rockford, Ill.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee Wis.
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Dings Magnetic Separator Co., Milwaukee, Wis.
Electric Coil Winding Co., Camden, N. J.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Electric Valve Mfg. Co., 64 Murray, New York
General Controls Co., San Francisco, Calif.
**General Electric Co., Schenectady, N. Y.**
**Guardian Electric Mfg. Co., 1621 W. Walnut, Chicago**
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
Penn Electric Switch Co., Goshen, Ind.
Ross Operating Valve Co., Detroit, Mich.
Stearns Magnetic Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wood Electric Co., Inc., C. D., 826 Broadway, New York

## SPEED REDUCING UNITS, GEAR

Abart Gear & Machine Co., 4834 W. 16th, Chicago
Alling-Lander Co., Sodus, N. Y.
**Allis-Chalmers Mfg. Co., 1126 South 70th St., West Allis, Wisc.**
Atlantic Gear Works, Inc., 128 Lafayette, New York
**Boston Gear Works, Inc., North Quincy, Mass.**
Chicago Gear Works, 769 W. Jackson Blvd. Chicago
Christian, J. D., San Francisco, Calif.
**Cullman Wheel Co., 1350 Altgeld, Chicago**
**DeLaval Steam Turbine Co., Trenton, N. J.**
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Buffalo, N. Y.
Foote Bros. Gear & Machine Corp., 5301 S. Western Blvd., Chicago
Foote Gear Works, Inc., Cicero, Ill.

*in bold face type, see index on last page*

Courtesy of Thew Shovel Co.

**in gruelling power shovel work**

. . . for precision adjustment of the bearing for the power (swing) shaft of this Lorain shovel. "We also"—reports the Thew Shovel Company—"use Laminum shims in the bearings of the hoist shaft and in several other places throughout the machine where fine adjustment is necessary." Laminum sample on request.

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***Quality Spring Manufacture***

**DUNBAR BROS. CO.**

DIVISION OF ASSOCIATED SPRING CORPORATION

BRISTOL • CONNECTICUT

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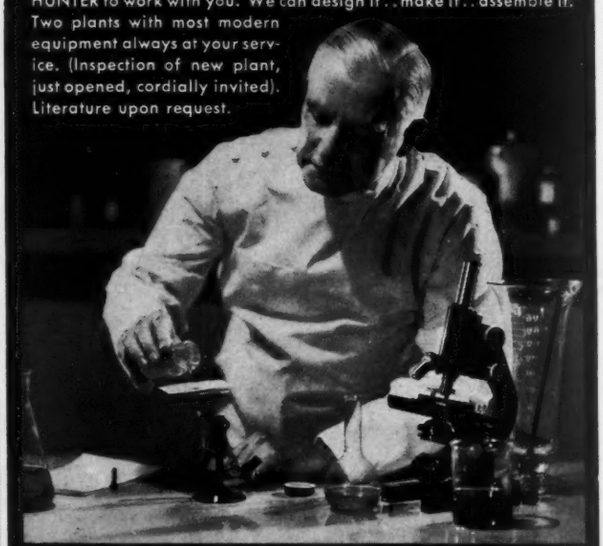

**HUNTER PRESSED STEEL COMPANY**

LANSDALE, PENNSYLVANIA

**SPEED REDUCING UNITS, GEAR**

**General Electric Co., Schenectady, N. Y.**

Graham Transmissions, 2711 N. 13th, Milwaukee, Wis.

Grant Gear Works, Second & B Sts., Boston, Mass.

Illinois Gear & Machine Co., 2108 N. Natchez Ave., Chicago

James, D. O., Mfg. Co., 1114 W. Monroe, Chicago

Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.

Jones Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago

**Link-Belt Co., Indianapolis, Ind.**

Medart Co., The, 3500 DeKalb, St. Louis, Mo.

Meisel Press Mfg. Co., 944 Dorchester Ave., Boston, Mass.

Milwaukee Gear Co., Milwaukee, Wis.

Ohio Forge & Machine Corp., Cleveland, Ohio

**Ohio Gear Co., Cleveland, Ohio**

Palmer-Bee Co., Detroit, Mich.

Philadelphia Gear Works, Philadelphia, Pa.

Smith, W. H., Springville, Erie County, N. Y.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sterling Electric Motors, Inc., Los Angeles, Calif.

Sumner Iron Wks., Everett, Wash.

Universal Gear Corp., Indianapolis, Ind.

Watson-Flagg Machine Co., Paterson, N. J.

Western Gear Works, Seattle, Wash.

Westinghouse Nuttall Works, East Pittsburgh, Pa.

**SPINNINGS, METAL**

*Made to customer's specifications*

Bartlett-Thompson Co., Inc., 123 Swanton, Winchester, Mass.

Bergfels & Co., Inc., 44 Walnut, Newark, N. J.

Bridgeport Brass Co., Bridgeport, Conn.

Chase Brass & Copper Co., Waterbury, Conn.

Imperial Brass Mfg. Co., 1214 W. Harrison, Chicago

Milwaukee Metal Spinnings Co., 1321 S. 43d St., Milwaukee, Wis.

Nangatuck Mfg. Co., Nangatuck, Conn.

Premier Metal Wks., Inc., 1612 S. Clinton, Chicago

Superior Metal Spinning & Mfg. Co., Toledo, Ohio

Universal Oil Seal Co., Inc., Pontiac, Mich.

**SPRINGS**

*All types of coil, flat, wire forms, snap and lock styles.*

Accurate Spring Mfg. Co., 3811 W. Lake, Chicago

American Locomotive Co., 30 Church, New York

American Spiral Spring & Mfg. Co., 5540 Harrison, Pittsburgh, Pa.

American Spring & Mfg. Corp., Holly, Mich.

American Spring & Wire Specialty Co., 816 N. Spaulding Ave., Chicago

**American Steel & Wire Co., Cleveland, Ohio**

**Barnes Co., Wallace, Div. Associated Spring Corp., Bristol, Conn.**

**Barnes-Gibson-Raymond, Div. Associated Spring Corp., Detroit, Mich.**

Chicago Coil Spring Co., 330 N. Albany Ave., Chicago

Cleveland Wire Spring Co., Cleveland, Ohio

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Crucible Steel Co. of America, 405 Lexington Ave., New York

**Cuyahoga Spring Co., Cleveland, Ohio**

Danly Machine Specialties, 2111 S. 52nd Ave., Chicago

**Dunbar Bros. Co., Div. Associated Spring Corp., Bristol, Conn.**

Easton Tool & Stamping Co., Inc., Saugus, Mass.

Eaton Mfg. Co., Cleveland, Ohio

Fischer Spring Co., 240 Kent Ave., Brooklyn, N. Y.

General Spring Co., Cincinnati, Ohio

General Wire Spring Co., Pittsburgh, Pa.

**Gibson Co., Wm. D., 1800 Clybourn Ave., Chicago**

Grammes, L. F., & Sons, Inc., Allentown, Pa.

Hebb Spring Works, Newark, N. J.

Hubbard, M. D., Spring Co., Pontiac, Mich.

Humason Mfg. Co., Forestville, Conn.

**Hunter Pressed Steel Co., Lansdale, Pa.**

Lee Spring Co., 30 Main, Brooklyn, N. Y.

Mattatuck Mfg. Co., Waterbury, Conn.

Miller & Van Winkle, Inc., 20 Bridge, Brooklyn, N. Y.

Muehlhausen Spring Co., Logansport, Ind.

***For further information on companies listed***

National Motor Bearing Co., Inc., Oakland, Calif.

New Britain Spring Co., New Britain, Conn.

Newcomb Spring Corp., 237-40th, Brooklyn, N. Y.

**Peck Spring Co., Plainville, Conn.**

Pratt & Letchworth Co., Inc., Buffalo, N. Y.

Raymond Mfg. Co., Corry, Pa.

Springfield Spring Co., Springfield, Ohio

Standard Spring & Mfg. Co., 241-42nd, Brooklyn, N. Y.

Stimpson, E. B., Co., 101 Franklin Ave., Brooklyn, N. Y.

Timms Spring Co., Elyria, Ohio

Titchener, E. H., & Co., Binghamton, N. Y.

Union Spring & Mfg. Co., New Kensington, Pa.

United Spring Corp., 431 Kent Ave., Brooklyn, N. Y.

**U. S. Steel Corp., 71 Broadway, New York**

U. S. Steel Wire Spring Co., Cleveland

Washburn Wire Co., Inc., Phillipsdale, R. I.

Wickwire Spencer Steel Co., 41 E. 42nd, New York

Yost Superior Co., Springfield, Ohio

Young Spring & Wire Corp., Detroit, Mich.

### SPRINGS, BELLEVILLE TYPE

*Cupped spring disks used singly or in stacks.*

Accurate Spring Mfg. Co., 3811 W. Lake, Chicago

**Barnes-Gibson-Raymond, Div. Associated Spring Corp., Detroit, Mich.**

**Barnes, Wallace, Co., Bristol, Conn.**

**Gibson, Wm. D., Co., 1800 Clybourn Ave., Chicago**

Hubbard, M. D., Spring Co., Pontiac, Mich.

Place, Roland P., Co., Midland, Mich.

Railway Steel Spring Div., American Locomotive Co., 30 Church St., New York

Timms Spring Co., Elyria, Ohio

Union Spring & Mfg. Co., New Kensington, Pa.

### SPRINGS, HAIR

*For instruments and gages*

Fischer, Chas., Spring Co., 240 Kent Ave., Brooklyn, N. Y.

Instrument Specialties Co., Little Falls, N. J.

Mauross, F. N., & Sons, Div. of Associated Spring Corp., Forrestville, Conn.

Mid-West Spring Mfg. Co., 4636 S. Western Ave., Chicago

New Britain Spring Co., 696 W. Main, New Britain, Conn.

Precision Products Co., Waltham, Mass.

Steel, H. D., Co., 439 Chestnut, Philadelphia, Pa.

### STAMPINGS

*General sheet and metal press work*

Accurate Spring Mfg. Co., 3811 W. Lake, Chicago

Ainsworth Mfg. Corp., Detroit, Mich.

Akron-Selle Co., Akron, Ohio

**Aluminum Goods Mfg. Co., Manitowoc, Wis.**

**American Brass Co., Waterbury, Conn.**

**American Emblem Co., Inc., Box 116 E., Utica, N. Y.**

Ansonia Mfg. Co., Ansonia, Conn.

Auburn Mfg. Co., Middletown, Conn.

**Barnes-Gibson-Raymond, Div. Associated Spring Corp., Detroit, Mich.**

**Barnes, Wallace, Co., Div. Associated Spring Corp., Bristol, Conn.**

Bay State Stamping Co., Worcester, Mass.

Bettcher Stamping & Mfg. Co., Cleveland, Ohio

Bossert Corp., The, Utica, N. Y.

Bowen Products Corp., Auburn, N. Y.

Brewer-Titchener Corp., Cortland, N. Y.

**Bridgeport Brass Co., Bridgeport, Conn.**

Bridgeport Chain & Mfg. Co., Bridgeport, Conn.

Briggs Mfg. Co., Detroit, Mich.

Chase Brass & Copper Co., Waterbury, Conn.

Crosby Co., Buffalo, N. Y.

Dahlstrom Metallic Door Co., Jamestown, N. Y.

Defiance Pressed Steel Co., Defiance, Ohio

Detroit Stamping Co., Detroit, Mich.

Dickey-Grabler Co., 10302 Madison Ave., Cleveland, Ohio

**Dunbar Bros. Div. Associated Spring Corp.**

Edwards Mfg. Co., Cincinnati, Ohio

Erie Art Metal Co., Inc., Erie, Pa.

Faries Mfg. Co., Decatur, Ill.

Forsyth Metal Goods Co., Aurora, Ill.

Fostoria Pressed Steel Co., Fostoria, Ohio

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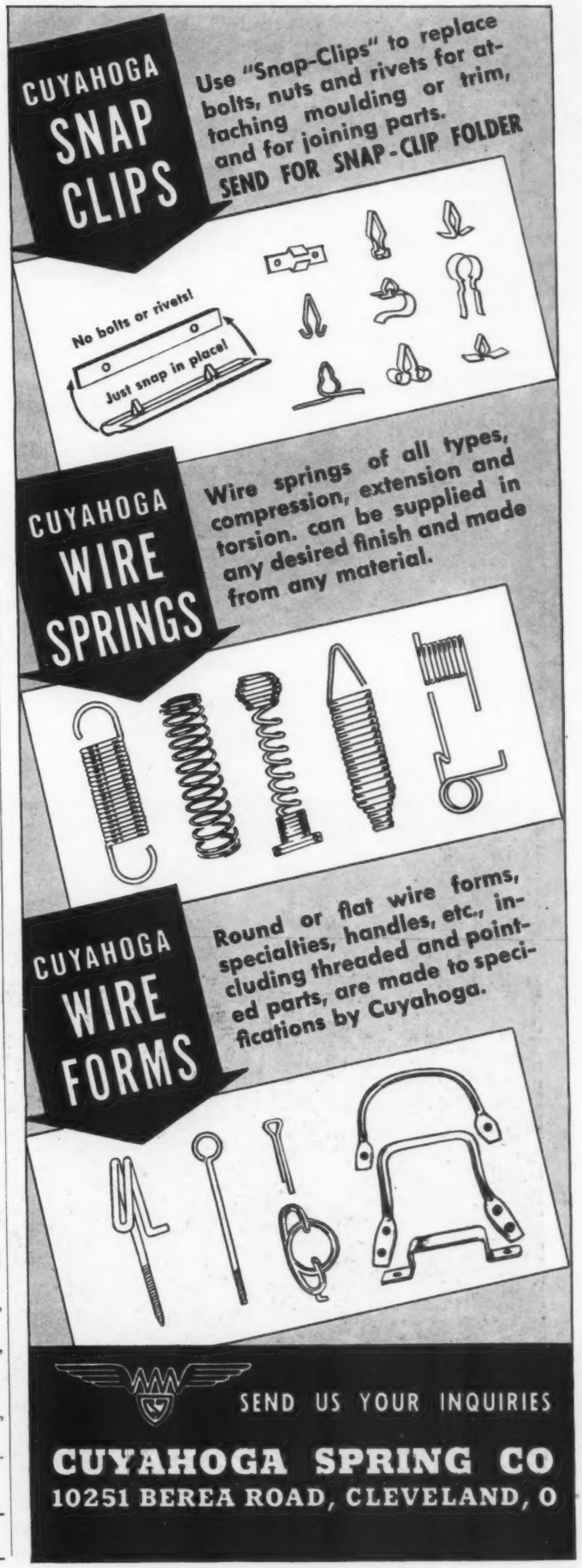
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SNAP CLIPS
Use "Snap-Clips" to replace bolts, nuts and rivets for attaching moulding or trim, and for joining parts.
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No bolts or rivets!
Just snap in place!
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Round or flat wire forms, specialties, handles, etc., including threaded and pointed parts, are made to specifications by Cuyahoga.
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10251 BEREA ROAD, CLEVELAND, O

**STAMPINGS (Con't)**

Franklin Fibre-Lamitex Corp., Wilmington, Del. (Bakelite and fibre)

**Gibson, Wm. D., Co., 1800 Clybourn Ave., Chicago**

Goetze Gasket & Packing Co., New Brunswick, N. J.

Grabler Mfg. Co., Cleveland, Ohio

Gregory Mfg. Co., Mt. Carmel, Conn.

**International Insulating Div., General Industries Co., Elyria, Ohio**

General Metal Products Co., St. Louis, Mo.

Geometric Stamping Co., Euclid, Ohio

Grammes, L. F., & Sons, Inc., Allentown, Pa.

Greist Mfg. Co., New Haven, Conn.

Hubbard, M. D., Spring Co., Pontiac, Mich.

**Hunter Pressed Steel Co., Landsdale, Pa.**

Industrial Engng. & Mfg. Co., 239 John St., Bridgeport, Conn.

**Laminated Shim Co., Inc., 44th Ave., Long Island City, N. Y.**

Lansing Stamping Co., Lansing, Mich.

McCord Radiator & Mfg. Co., Detroit, Mich.

Midland Steel Products Co., Cleveland, Ohio

Milwaukee Stamping Co., Milwaukee, Wis.

National Brass Co., Grand Rapids, Mich.

National Motor Bearing Co., Inc., Oakland, Calif.

National Stamping Co., Detroit, Mich.

New Products Corp., Benton Harbor, Mich.

Parish Pressed Steel Co., Reading, Pa.

Pheoll Mfg. Co., Roosevelt Rd., Chicago

Plume & Atwood Mfg. Co., Waterbury, Conn.

Powell Pressed Steel Co., Hubbard, Ohio

Prentice, G. E., Mfg. Co., New Britain, Conn.

Raymond Mfg. Co., Corry, Pa.

Revere Copper & Brass, Inc., Rome, N. Y.

Rockwood Sprinkler Co., Worcester, Mass.

Saginaw Stamping & Tool Co., Saginaw, Mich.

**Scovill Mfg. Co. Waterbury, Conn.**

Sessions, J. H., & Sons, Bristol, Conn.

**Standard Pressed Steel Co., Jenkintown, Pa.**

Standard Spring & Mfg. Co., Inc., 236-42nd, Brooklyn, N. Y.

Sheet Metal Specialty Co., Pittsburgh, Pa.

Stanley Works, New Britain, Conn.

Stimpson, Edwin B., Co., 92 Franklin, Brooklyn, N. Y.

Tichenor & Co., Binghamton, N. Y.

**Torrington Mfg. Co., Torrington, Conn.**

**Transue & Williams Steel Forging Corp., Alliance, Ohio**

Union Spring & Mfg. Co., New Kensington, Pa.

United Carr Fastener Corp., Cambridge, Mass.

United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio

U. S. Indestructible Gasket Co., 829 E. 15th, Brooklyn, N. Y.

**Veeder-Root, Inc., Hartford, Conn.**

Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago

Western Cartridge Co., East Alton, Ill.

Whitehead Stamping Co., Detroit, Mich.

Wilcox, Crittenden & Co., Middletown, Conn.

Worcester Pressed Steel Co., Worcester, Mass.

Wrought Washer Mfg. Co., Milwaukee, Wis.

Youngstown Pressed Steel Co., Warren, Ohio

**STRUCTURAL SHAPES, BRASS AND BRONZE**

**American Brass Co., Waterbury, Conn.**

Bohn Aluminum & Brass Corp., 1400 Lafayette Bldg., Detroit, Mich.

Revere Copper & Brass, Inc., 230 Park Ave., New York

**STRUCTURAL SHAPES, CARBON STEELS**

Bethlehem Steel Co., Bethlehem, Pa.

**Carniegie-Illinois Steel Corp., Pittsburgh, Pa.**

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Inland Steel Co., 38 S. Dearborn, Chicago

Republic Steel Corp., Cleveland, Ohio

Rockford Bolt & Steel Co., Rockford, Ill.

***For further information on companies listed***

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WILLIAM D. GIBSON COMPANY
DIV. OF ASSOC. SPRING CORP. 1800 CLYBOURN AVE., CHICAGO, ILL.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

**U. S. Steel Corp., 71 Broadway, New York**

### STRUCTURAL SHAPES, LOW ALLOY STEEL

Bethlehem Steel Co. Bethlehem, Pa.

**Carnegie-Illinois Steel Corp., Pittsburgh, Pa.**

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Inland Steel Co., 38 S. Dearborn, Chicago

Republic Steel Corp., Cleveland, Ohio

**U. S. Steel Corp., 71 Broadway, New York**

### SWITCHES, APPLIANCE

*Small switches for portable tools and appliances, for built-in or cord mountings.*

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Bridgeport Switch Co., Bridgeport, Conn.

Bryant Electric Co., Bridgeport, Conn.

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

Connecticut Electric Mfg. Co., Bantam, Conn.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.

Eagle Electric Mfg. Co., Inc., 59 Hall, Brooklyn, N. Y.

**General Electric Co., Bridgeport, Conn.**

Hart Mfg. Co., Hartford, Conn.

Hubbell, Inc., Harvey, Bridgeport Conn.

**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**

Pass & Seymour, Inc., Syracuse, N. Y.

Rhodes, M. H., Inc., Hartford, Conn.

Trumbull Electric Mfg. Co., Plainville, Conn.

Weber Electric Co., Schenectady, N. Y.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### SWITCHES, CORD

Connecticut Electric Mfg. Co., Bantam, Conn.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.

Eagle Electric Mfg. Co., Inc., 59 Hall, Brooklyn, N. Y.

**General Electric Co., Bridgeport, Conn.**

Molded Insulation Co., 3246 Ludlow, Philadelphia, Pa.

Wood, C. D., Electric Co., Inc., 826 Broadway, New York

### SWITCHES, FLOAT

*For controlling pumps or tell-tale lights on tanks*

Allen-Bradley Co., Milwaukee, Wis.

**Brown Instrument Co., Philadelphia, Pa.**

Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.

Electric Controller & Mfg. Co., Cleveland, Ohio

Furnas Electric Co., West Allis, Wis.

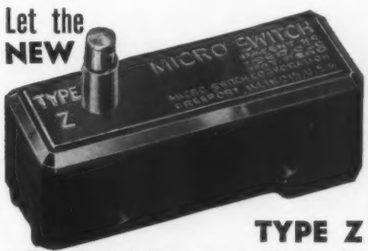
**General Electric Co., Schenectady, N. Y.**

Hart Mfg. Co., Hartford, Conn.

Jefferson Electric Co., Bellwood, Ill.

*in bold face type, see index on last page*


Let the NEW




TYPE Z

1—Heater Loads 1200 watts up to 600 volts. Inductive loads, solenoids, relays, etc., A.C.
2—Operates on 0.0002" to 0.0003" movement (Triple zero)—8½ oz. pressure.
3—Can be used in any position—vibration resistant.
4—60 or more snaps per minute—millions of operations.
5—Underwriters' Laboratories listing and Ontario H. E. P. C. approval. Size 1 15/16"x27/32"x 11/16".

MICRO SWITCH

Solve Your Out-of-Ordinary Electric Contact Problems—

A new super-sensitive Micro Switch. Operating pressure, 8½ oz.; release pressure, 6½ oz.; movement differential 0.0003". For thermostat, flame and fan control in **Air Conditioning**; in metal housings for limit stops in **Machine Tools**; for thermostats in **Incubators**; for controls in **Instruments**; for stops in **Business Machines**; and hundreds of other uses. Write for specifications and recommendations covering Z Switch applications.

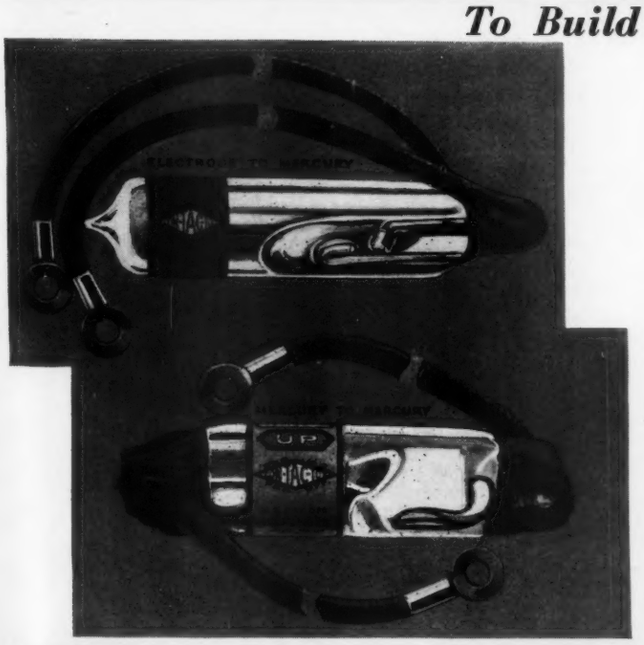
MICRO SWITCH
5 East Spring Street

MS

CORPORATION
Freeport, Ill., U.S.A.

Build in CON-TAC-TOR REG. U.S. PAT. OFF. MERCURY SWITCHES

*To Build Product Acceptance and Sales*



Dependable performance of all automatic timing, operating and controlling devices rests upon unfailing switch action. That's why so many manufacturers of automatic machinery build-in Con-Tac-Tor "Sealed Switching" . . . for lasting, trouble-free service.

Con-Tac-Tor Mercury Switch action is smooth—with extremely low electrical contact resistance—unhampered by wear of mechanical parts or alteration of operating characteristics.

In a very compact space Con-Tac-Tor Mercury Switches offer a wide range of high capacities. Electrode to mercury type switches are available for loads up to 10 amps. at 110 volts and 5 amps. at 200 volts. Mercury to mercury switches are made for ratings from 10 to 45 amps. at 110 volts.

Investigate the possibilities of economy and improved performance of your equipment with Con-Tac-Tor Mercury Switches. Write THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4459 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street . . . Amsterdam-C, Holland: Wijdesteeg 4 . . . London 4, England: 70 St. Thomas' Street, S.E.1.

BROWN INSTRUMENTS
AND
MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS

*To Measure and Control is to Economize*

### SWITCHES, FLOAT (Con't)

Kel-San Mfg. Co., Dayton, Ohio
McDonnell-Miller Co., Wrigley Bldg., Chicago
Mercoid Corp., 4203 Belmont Ave., Chicago
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Rochester Mfg. Co., Rochester, N. Y.
Rowan Controller Co., Baltimore, Md.
**Square D Co., Detroit, Mich.**
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsurgh, Pa.

### SWITCHES, KNIFE

*Type, manually operated*

Automatic Reclosing Circuit Breaker Co., Columbus, Ohio
Bridgeport Switch Co., Bridgeport, Conn.
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.
Crouse-Hinds Co., Syracuse, N. Y.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.
Electric Controller & Mfg. Co., 2700 East 79th, Cleveland, Ohio
**General Electric Co., Schenectady, N. Y.**
Kolton Electric Mfg. Co., Newark, N. J.
Laganke Electric Co., Cleveland, Ohio
Leonard Electric Co., Cleveland, Ohio
Metropolitan Electric Mfg. Co., Long Island City, N. Y.
Penn Electrical Co., Irwin, Pa.
Plainville Electrical Products Co., Plainville, Conn.
Powerlite Switchboard Co., Cleveland, Ohio
Trumbull Electric Mfg. Co., Plainville, Conn.
Ward Electric Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Eagle Electric Mfg. Co., Inc., 59 Hall, Brooklyn, N. Y.
Gregory Mfg. Co., Mt. Carmel, Conn.
Heinemann Electric Co., Trenton, N. J.
Molded Insulation Co., 3246 Ludlow, Philadelphia, Pa.
**Square D Co., Detroit, Mich.**
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

### SWITCHES, LIMIT

*Lever, cam or gear operated switches for travel and speed control*

Allen-Bradley Co., Milwaukee, Wis.
Anderson, C. J., & Co., 212 W. Hubbard, Chicago
Barber-Colman Co., Rockford, Ill.
Clark Controller Co., Cleveland, Ohio
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.
**Dunn, Inc., Struthers, Philadelphia, Pa.**
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Euclid Electric & Mfg. Co., Euclid, Ohio
Furnas Electric Co., West Allis, Wis.
**General Electric Co., Schenectady, N. Y.**
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**
Monitor Controller Co., Baltimore, Md.
Partlow Corp., New Hartford, N. Y.
Penn Electric Switch Co., Goshen, Ind.
Production Instrument Co., 710 W. Jackson Blvd., Chicago
Rhodes, M. H., Inc., Hartford, Conn.
Rowan Controller Co., Baltimore, Md.
**Spencer Thermostat Co., Attleboro, Mass.**
Russell Electric Co., 340 W. Huron, Chicago
**Square D Co., Detroit, Mich.**
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
White-Rodgers Electric Co., St. Louis, Mo.

### SWITCHES, MAGNETICALLY OPERATED

**Allis-Chalmers Mfg. Co., 1126 S. 70 St., West Allis, Wis.**
Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**
Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio
Colt's Patent Fire Arms Mfg., Co., Hartford, Conn.
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.
**Dunn, Inc., Struthers, 146 N. Juniper, Philadelphia, Pa.**
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio
Euclid Electric & Mfg. Co., Chardon Rd., Euclid, Ohio
General Controls Co., 1370 Harrison, San Francisco, Calif.
**General Electric Co., Schenectady, N. Y.**
**Guardian Electric Mfg. Co., 1621 W. Walnut, Chicago**
H-B Electric Co., Inc., 2518 N. Broad, Philadelphia, Pa.
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
Kolton Electric Mfg. Co., Newark, N. J.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Rowan Controller Co., Baltimore, Md.
Signal Engineering & Mfg. Co., 144 W. 14th, New York
Tork Clock Co., Inc., Mr. Vernon, N. Y.

### SWITCHES, MERCURY TYPE

*Swiches equipped with a tilting mercury tube for making and breaking contact*

Acme Electric Heating Co., 1217 Washington, Boston. Mass.
**Brown Instrument Co., Philadelphia, Pa.**
Continental Electric Co., Geneva, Ill.
**Dunn, Inc., Struthers, Philadelphia, Pa.**
Durakool, Inc., 1010 N. Main St., Elkhart, Ind.
**General Electric Co., Bridgeport, Conn.**
G-M Laboratories Inc., 1735 Belmont Ave., Chicago
Hart Mfg. Co., Hartford, Conn.
H-B Electric Co., Inc., 2518 N. Broad, Philadelphia, Pa.
Jefferson Electric Co., Bellwood, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago
**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**
Powrex Switch Co., Waltham, Mass.
Tork Clock Co., Inc., Mr. Vernon, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### SWITCHES, SMALL SENSITIVELY ACTUATED

Burgess Laboratories, C. F., Freeport, Ill.
**General Electric Co., Schenectady, N. Y.**
G-M Laboratories Inc., 1735 Belmont Ave., Chicago
**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**
Partlow Corp., New Hartford, N. Y.
Russell Electric Co., 340 W. Huron, Chicago.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

### SWITCHES, PRESSURE CONTROL

*Automatic switches operated by movement of a diaphragm or similar device*

Allen-Bradley Co., Milwaukee, Wis.
Automatic Temperature Control Co., Inc., 34 E. Logan, Philadelphia, Pa.
Bristol Co., Waterbury, Conn.
**Brown Instrument Co., Philadelphia, Pa.**
Clark Controller Co., 1146 E. 152nd, Cleveland, Ohio
Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.
Dickson Co., 7420 Woodlawn Ave., Chicago
Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Electric Controller & Mfg. Co., Cleveland, Ohio
Electric Switch Corp., Columbus, Ind.
Engelhard, Charles, Newark, N. J.
**General Electric Co., Schenectady, N. Y.**
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
Kel-San Mfg Co., Dayton, Ohio
Mercoid Corp., 4203 Belmont Ave., Chicago
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Ranco Inc., Columbus, Ohio
Rochester Mfg. Co., Rochester, N. Y.
**Spencer Thermostat Co., Attleboro, Mass.**
Signal Engineering & Mfg. Co., 144 W. 14th, New York
**Square D Co., Detroit, Mich.**
Tagliabue, C. J., Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.
Taylor Instrument Cos., Rochester, N. Y.
Ward Leonard Electric Co., Mt. Vernon, N. Y.
Warren Electric Appliance Co., Warren, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
White-Rodgers Electric Co., St. Louis, Mo.

***For further information on companies listed***

**SWITCHES, TEMPERATURE CONTROL BI-METAL TYPE**

Acme Electric Heating Co., 1217 Washington, Boston, Mass.

Automatic Temperature Control Co., Inc., 34 E. Logan, Philadelphia, Pa.

Barber-Colman Co., Rockford, Ill.

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Dickson Co., 7420 Woodlawn Ave., Chicago

**Dunn, Struthers, Inc., 146 N. Juniper, Philadelphia, Pa.**

Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio

General Controls Co., 1370 Harrison, San Francisco, Calif.

**General Electric Co., Schenectady, N. Y.**

**Guardian Electric Mfg. Co., 1621 W. Walnut, Chicago**

Jefferson Electric Co., Bellwood, Ill.

McCorkle, D. H., Co., Berkeley, Calif.

**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**

Penn Electric Switch Co., Goshen, Ind.

Ranco Inc., Columbus, Ohio

Russell Electric Co., 340 W. Huron, Chicago

Signal Engineering & Mfg. Co., 144 W. 14th, New York

**Spencer Thermostat Co., Attleboro, Mass.**

Ward Leonard Electric Co., Mt. Vernon, N. Y.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**SWITCHES, TEMPERATURE CONTROL**

*Gas and Liquid Type*

Automatic Temperature Control Co., Inc., 34 E. Logan, Philadelphia, Pa.

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Dickson Co., 7420 Woodlawn Ave., Chicago

Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.

Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio

G-M Laboratories, Inc., 1735 Belmont Ave., Chicago

**General Electric Co., Schenectady, N. Y.**

H-B Instrument Co., 2518 N. Broad, Philadelphia, Pa.

Jefferson Electric Co., Bellwood, Ill.

Partlow Corp., New Hartford, N. Y.

Penn Electric Switch Co., Goshen, Ind.

Ranco Inc., Columbus, Ohio

Rochester Mfg. Co., Rochester, N. Y.

**Spencer Thermostat Co., Attleboro, Mass.**

**Square D Co., Detroit, Mich.**

Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.

Ward Leonard Electric Co., Mt. Vernon, N. Y.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

White-Rodgers Elec. Co., St. Louis, Mo.

**TACHOMETERS**

*For showing speed of revolution*

Biddle, J. G., Co., 1211 Arch, Philadelphia, Pa.

Bristol, Co., Waterbury, Conn.

**Brown Instrument Co., Philadelphia, Pa.**

**Corbin Screw Corp., New Britain, Conn.**

Cramer & Co., Inc. 67 Irving Place, New York

**Durant Mfg. Co., 1938 N. Buffum, Milwaukee, Wis.**

Electric Tachometer Co., Philadelphia, Pa.

**General Electric Co., Schenectady, N. Y.**

General Radio Co., Cambridge, Mass.

Hasler-Tel Co., 461-8th Ave., New York

Precision Thermometer & Instrument Co., Philadelphia, Pa.

Roller-Smith Co., 233 Broadway, New York

Starrett, L. S. Co., Athol, Mass.

Stewart, F. W., Mfg. Corp., 340 W. Huron, Chicago

**Stewart-Warner Corp., 1826 Diversey Parkway, Chicago**

Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.

**Veeder-Root, Inc., Hartford Conn.**

Waltham Watch Co., Waltham, Mass.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Weston Electrical Instrument Corp., Newark, N. J.

Zernickow, O., Co., 15 Park Row, New York

**TANTALUM**

*Castings, rods, draw, sheets, rubing, wire, bars.*

Bishop, J., & Co., Platinum Works, 12 Channing Ave., Malvern, Pa.

Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit, Mich. (carbides)

Fansteel Metallurgical Corp., North Chicago, Ill.

**SPEED INDICATORS**

(*See Tachometer*)

**STAINLESS STEEL**

(*See Bars, Steel Alloy; Castings, Stainless Steel, Sheets and Strips, Stainless; Wire, Alloy Steel*)

**THERMOMETERS, INDUSTRIAL**

*For temperature indication; mercury in glass, liquid or vapor types for remote indications*

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., Philadelphia, Pa.**

Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Dickson Co., 7420 Woodlawn Ave., Chicago

Electric Auto-Lite Co., La Crosse, Wis.

Engelhard, C., Inc., Newark, N. J.

H-B Instruments Co., Inc., Philadelphia, Pa.

Ideal Commutator Dresser Co., Sycamore, Ill.

Leeds & Northrup Co., Philadelphia, Pa.

Liquidometer Corp., Long Island City, N. Y.

Marsh, Jas. P., Corp., 2077 Southport Ave., Chicago

**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**

National Gauge Corp., 300 Pacific, Brooklyn, N. Y.

Palmer Co., The, Cincinnati, Ohio

Partlow Corp., New Hartford, N. Y.

Precision Thermometer & Instrument Co., Philadelphia, Pa.

Pyrometer Instrument Co., 103 Lafayette, New York

Rochester Mfg. Co., Rochester, N. Y.

Tagliabue, C. J., Mfg. Co., 550 Park, Brooklyn, N. Y.

Taylor Instrument Cos., Rochester, N. Y.

United States Gauge Co., 44 Beaver, New York

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Weston Elec. Instrument Corp., 641 Frelinghuysen Ave., Newark, N. J.

Whittier Co., H. R., Pequabuck, Conn.

**THERMOSTATS**

*For temperature control, operated by a bi-metal element or by expansion of bellows or diaphrams*

Acme Electric Heating Co., 1217 Washington, Boston, Mass.

Automatic Reclosing Circuit Breaker Co., Columbus, Ohio

**Bridgeport Thermostat Co., Inc., Bridgeport, Conn.**

Barber-Coleman Co., Rockford, Ill.

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Burling Instrument Co., Newark, N. J.

Cleveland Steel Products Corp., Wellington, Ohio

Cramer, R. W., & Co., Inc., 67 Irving Place, New York

Detroit Lubricator Co., Detroit

Dickson Co., 7429 Woodlawn Ave., Chicago

Dole Valve Co., 1901 Carroll Ave., Chicago

**Dunn, Struthers, Inc., Philadelphia, Pa.**

Foxboro Co., Foxboro, Mass.

**Fulton Sylphon Co., Knoxville, Tenn.**

Gamewell Co., Newton, Mass.

General Controls Co., 1370 Harrison, San Francisco, Calif.

**General Electric Co., Bridgeport, Conn.**

**General Plate Co., 40 Forest, Attleboro, Mass.**

H-B Instruments Co., Inc., Philadelphia, Pa.

Hart Mfg. Co., Hartford, Conn.

Jefferson Electric Co., Bellwood, Ill.

Mercoid Corp., 4201 Belmont Ave., Chicago

**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**

McCorkle, D. H., Co., Berkeley, Calif.

**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**

Partlow Corp., New Hartford, N. Y.

Penn Electric Switch Co., Goshen, Ind.

Precision Thermometer & Instrument Co., Philadelphia, Pa.

Ranco Inc., Columbus, Ohio

Russell Electric Co., 340 W. Huron, Chicago

**Spencer Thermostat Co., Attleboro, Mass**

Tagliabue, C. J., Mfg. Co., 550 Park, Brooklyn, N. Y.

Taylor Instrument Cos., Rochester, N. Y.

Ulanet, Geo., Co., Newark, N. J.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Warren Electric Appliance Co., Warren, Pa.

*in bold face type, see index on last page*

**THERMOSTATS (Con't)**

White-Rodgers Electric Co., St. Louis, Mo.

**TIMERS, ELECTRIC**

*Time switches operated by . . mechanical or electric clock . . mechanism.*

Allen-Bradley Co., Milwaukee, Wis.

Automatic Electric Co., 1033 W. Van Buren, Chicago

Automatic Temperature Control Co., Inc., 34 E. Logan, Philadelphia, Pa.

Barber-Colman Co., Rockford, Ill.

Bristol Co., Waterbury, Conn.

Buckeye Time Switches, Inc., Cleveland, Ohio

Clark Controller Co., Cleveland, Ohio

Cleveland Time Clock & Service Co., Cleveland, Ohio

Cramer, R. W., & Co., Inc., 67 Irving Place, New York

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee Wis.

**Dunn, Struthers, Inc., Philadelphia, Pa.**

Eagle Signal Corp., Moline, Ill.

Electric Controls Corp., 68 Murray, New York

Electric Controller & Mfg. Co., 2700 E. 79th, Cleveland, Ohio

Electric Tachometer Corp., Philadelphia, Pa.

**General Electric Co., Schenectady, N. Y.**

**Guardian Electric Mfg. Co., 1621 W. Walnut, Chicago**

Lexington Electric Products Co., Newark, N. J.

Mercoid Corp., 4203 Belmont Ave., Chicago

**Micro Switch Corp., 5 E. Spring, Freeport, Ill.**

Monitor Controller Co., Baltimore, Md.

New Haven Clock Co., New Haven, Conn.

Northwestern Clock Co., Omaha, Neb.

Penn Electric Switch Co., Goshen, Ind.

Perfex Controls Co., Milwaukee, Wis.

Production Instrument Co., 710 W. Jackson Blvd., Chicago

Rawson Electrical Instrument Co., Cambridge, Mass.

Reliance Automatic Lighting Co., Racine, Wis.

Rhodes, M. H., Inc., Hartford, Conn.

Russell Electric Co., 340 West Huron, Chicago

Sangamo Electric Co., Springfield, Ill.

Signal Engineering & Mfg. Co., 144 W. 14th, New York

**Spencer Thermostat Co., Attleboro, Mass.**

**Square D Co., Milwaukee, Wis.**

Stromberg Electric Co., 233 W. Erie, Chicago

Thompson, H. C., Clock Co., Bristol, Conn.

Tork Clock Co., Inc., Mt. Vernon, N. Y.

Walser Automatic Timer Co., Graybar Bldg., New York

Ward Leonard Electric Co., Mt. Vernon, N. Y.

Warren Telechron Co., Ashland, Mass.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

White-Rodgers Electric Co., St. Louis, Mo.

**TRANSMISSIONS, HYDRAULIC TYPE, VARIABLE SPEED**

American Engineering Co., Philadelphia, Pa.

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

Northern Pump Co., Minneapolis, Minn.

Oilgear Co., Milwaukee, Wis.

Waterbury Tool Co., Waterbury, Conn.

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

**TRANSMISSIONS, MECHANICAL TYPE, VARIABLE SPEED**

**Allis-Chalmers Mfg. Co., 1126 S. 70th, West Allis, Wis.**

Dodge Mfg. Corp., Mishawaka, Ind.

Equipment Engineering Co., Minneapolis, Minn.

Falk Corp., Milwaukee, Wis.

Graham Transmissions, 2711 N. 13th, Milwaukee, Wis.

Hill Clutch Machine & Foundry Co., Cleveland, Ohio

Hunter Machine Co., North Adams, Mass.

Johnson Gear & Mfg. Co., Ltd., Berkeley, Calif.

Lenney Machine & Mfg. Co., Warren, Ohio

Lewellen Mfg. Co., Columbus, Ind.

**Link-Belt Co., 307 N. Michigan Ave., Chicago**

Morse Chain Co., Ithaca, N. Y.

**New Departure Mfg. Co., Bristol, Conn.**

Oilgear Co., Milwaukee, Wis.

Philadelphia Gear Wks., Philadelphia, Pa.

**Reeves Pulley Co., Columbus, Ind.**

Smith, W. H., Springville, N. Y.

Stephens-Adamson Mfg. Co., Aurora, Ill.

Sterling Electric Motors, Inc., Los Angeles, Calif.

U. S. Electrical Motors, Inc., Los Angeles, Calif.

Universal Gear Corp., Indianapolis, Ind.

Western Gear Works, Seattle, Wash.

**TRANSFORMERS, CURRENT AND POTENTIAL**

*For machine and instrument mounting*

American Transformer Co., 172 Emmet, Newark, N. J.

Davis & Co., Inc., Dean W., 547 W. Fulton, Chicago

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York

**General Electric Co., Schenectady, N. Y.**

General Radio Co., State, Cambridge, Mass.

Jefferson Electric Co., Bellwood, Ill.

Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill. (Luminous tube types)

Roller-Smith Co., 233 Broadway, New York

Sangamo Electric Co., Springfield, Ill.

United Transformer Corp., 72 Spring, New York

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**TUBING, ALUMINUM SEAMLESS, EXTRUDED OR DRAWN**

**Aluminum Co. of America, 2193 Gulf Bldg., Pittsburgh, Pa.**

**American Brass Co., Waterbury, Conn.**

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

Nicralumin Co., Jackson, Mich.

Parker Appliance Co., Cleveland, Ohio

Roberts Tube Works, Detroit, Mich.

Summerill Tubing Co., Bridgeport, Pa.

Superior Tube Co., Norristown, Pa.

Wolverine Tube Co., Detroit, Mich.

**TUBING, ALUMINUM**

*Capillary bores*

Summerill Tubing Co., Bridgeport, Pa.

Superior Tube Co., Norristown, Pa.

Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

When *Reliability* Counts *Specify*

Timers BY DUNCO

*Write for new Catalog —it's free!*

STRUTHERS DUNN, INC.
146 N. Juniper St., Philadelphia, Pa.

***For further information on companies listed***

### TUBING, BRASS AND COPPER

*Seamless, extruded or drawn*

American Tube Works, 143 Sidney, Cambridge, Mass.

**American Brass Co., Waterbury, Conn.**

**Bridgeport Brass Co., Bridgeport, Conn.**

Chase Brass & Copper Co., Waterbury, Conn.

Conklin, T. E., Brass & Copper Co., Inc., 54 Lafayette, New York

**General Plate Co., 40 Forest St., Attleboro, Mass.**

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

Mueller Brass Co., Port Huron, Mich.

Parker Appliance Co., Cleveland, Ohio

Penn Brass & Copper Co., Erie, Pa.

Revere Copper & Brass, Inc., 230 Park Ave., New York

**Scovill Mfg. Co., Waterbury, Conn.**

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Summerill Tubing Co., Bridgeport, Pa.

Superior Tube Co., Norristown, Pa.

Western Cartridge Co., East Alton, Ill.

Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

### TUBING, BRASS AND COPPER

*Capillary bores*

**Bridgeport Brass Co., Bridgeport, Conn.**

Revere Copper & Brass Inc., 230 Park Ave., New York

Summerill Tubing Co., Bridgeport, Pa.

Superior Tube Co., Norristown, Pa.

Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

### TUBING, FIBER

(See Fiber, Vulcanized)

### TUBING, GOLD

American Platinum Works, Newark, N. J.

Baker & Co., 113 Astor, Newark, N. J.

Bishop, J., & Co., Platinum Works, 12 Channing Ave., Malvern, Pa.

**General Plate Co., 40 Forest, Attleboro, Mass.**

Goldsmith Bros. Smelting & Refining Co., 58 E. Washington, Chicago

Handy & Harman Co., 82 Fulton, New York

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

### TUBING, METALLIC FLEXIBLE

*For fluids under pressure*

Allegheny Steel Co., Brackenridge, Pa.

Almond, T. R., Mfg. Co., Ashburnham, Mass.

**American Brass Co., American Metal Hose Branch, Waterbury, Conn.**

Atlantic Metal Hose Co., 123 W. 64th, New York

Breeze Corp., Inc., Newark, N. J.

Bundy Tubing Co., Detroit, Mich.

Chicago Metal Hose Corp., Maywood, Ill.

Eclipse Aviation Corp., East Orange, N. J.

Flex-O-Tube Co., Detroit, Mich.

International Metal Hose Co., Cleveland, Ohio

Mueller Brass Co., Port Huron, Mich.

Parker Appliance Co., Cleveland, Ohio

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.

Seamlex Corp., Long Island City, N. Y.

Stow Mfg. Co., Inc., Binghamton, N. Y.

Titeflex Metal Hose Co., Newark, N. J.

United Metal Hose Co., Inc., 731 Garrison Ave., New York

Weatherhead Co., Cleveland, Ohio

### TUBING, NICKEL

*Thin walled in small diameters down to capillary sizes*

**General Plate Co., 40 Forest, Attleboro, Mass.**

Summerill Tubing Co., Bridgeport, Montgomery Co., Pa.

Superior Tube Co., Norristown, Pa.

### TUBING, RUBBER

(See Hose, Non-Metallic)

### TUBING, STEEL, SEAMLESS DRAWN

Allegheny Steel Co., Brackenridge, Pa.

Bishop, J., & Co., Platinum Works, 12 Channing Ave., Malvern, Pa. (cold drawn 18-8 stainless steel 1" O.D. and under to 0.012" O.D.)

**General Plate Co., 40 Forest, Attleboro, Mass.**

Globe Steel Tubes Co., Milwaukee, Wis.

Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Parker Appliance Co., Cleveland, Ohio

Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.

Pittsburgh Steel Co., Pittsburgh, Pa.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Sculy Steel Products Co., 1319 Wabansia Ave., Chicago

Summerill Tubing Co., Bridgeport, Montgomery Co., Pa.

Superior Tube Co., Norristown, Pa.

Timken Roller Bearing Co., Canton, Ohio

Taylor-Wharton Iron & Steel Co., Easton, Pa.

Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.

### TUBING, STEEL, WELDED

Allegheny Steel Co., Brackenridge, Pa.

Bundy Tubing Co., 10951 Hern Ave., Detroit, Mich.

Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.

Michigan Steel Tube Products Co., Detroit, Mich.

Midland Steel Products Co., Cleveland, Ohio

Parker Appliance Co., Cleveland, Ohio

Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.

Republic Steel Corp., Cleveland, Ohio

Steel & Tubes, Inc., Cleveland, Ohio

Toledo Steel Tube Co., Toledo, Ohio

Wheeling Steel Corp., Wheeling, W. Va.

### TUNGSTEN

Belmont Smelting & Refining Works, Inc., 307 Belmont Ave., Brooklyn, N. Y.

Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit, Mich (carbides)

Fansteel Metallurgical Corp., North Chicago, Ill.

Mallory, P. R., & Co., Indianapolis, Ind.

### TUNGSTEN CARBIDE AND HARD FACING MATERIALS

Air Reduction Sales Co., 60 E. 42nd, New York

Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit, Mich.

Colmonoy Inc., Los Nietos, Calif.

Haynes Stellite Co., E. 42nd, New York

Lincoln Electric Co., Cleveland, Ohio

Prosser, Thos., & Son, Platt St., New York

Stoody Co., Whittier, Calif.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

**Wilson, H. A., Co., Newark, N. J.**

### TURNBUCKLES

**American Cable Co., Inc., Wilkes Barre, Pa.**

Bayonne Bolt Corp., Bayonne, N. J.

Bethlehem Steel Co., Bethlehem, Pa.

Cleveland Hardware & Forging Co., 3270 E. 79th, Cleveland, Ohio

Grabler Mfg. Co., Cleveland, Ohio

Hartford Machine Screw Co., Hartford, Conn.

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

Leschen, A., & Sons Rope Co., Cleveland, Ohio

Oil Well Supply Co., Dallas, Tex.

Rockford Bolt & Steel Co., Rockford, Ill.

Roebling's, John A., Sons Co., Trenton, N. J.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

St. Louis Screw & Bolt Co., St. Louis, Mo.

Truscon Steel Co., Youngstown, Ohio

Upson-Walton Co., Cleveland, Ohio

Wilcox, Crittenden & Co., Middletown, Conn.

Williamsport Wire Rope Co., Williamsport, Pa.

### VALVES, AIR SERVICE

*For use in compressed air or gas lines*

**Alemite Div. Stewart Warner Corp., 1826 Diversey Parkway, Chicago**

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Buckeye Iron & Brass Works, 324 E. 3rd, Dayton, Ohio

Cash, A. W., Co., Decatur, Ill.

Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.

Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.

Crane Co., 836 S. Michigan Ave., Chicago

Curtis Pneumatic Machy. Co., 1905 Keinlen Ave., St. Louis, Mo.

Electric Valve Mfg. Co., 68 Murray, New York

Fairbanks Co., 393 Lafayette, New York

Foster Engineering Co., Newark, N. J.

Hannifin Mfg. Co., 623 S. Kolmar Ave., Chicago

Homestead Valve Mfg. Co., Corapolis, Pa.

Jenkins Bros., 80 White, New York

Kennedy Valve Mfg. Co., Elmira, N. Y.

Marsh, J. P., Corp., 2073 Southport Ave., Chicago

*in bold face type, see index on last page*

**VALVES, AIR SERVICE (Con't)**

Nathan Mfg. Co., 250 Park Ave., New York

Northern Equipment Co., Erie, Pa.

Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Plouff Co., 1150 Columbus Ave., Boston, Mass.

Powell, Wm., Co., Cincinnati, Ohio

Q. C. Engineering Products, Detroit, Mich.

Ross Operating Valve Co., Detroit, Mich.

R-S Products Corp., Philadelphia, Pa.

Sumner Iron Wks., Everett, Wash.

Strong, Carlisle & Hammond Co., Cleveland, Ohio

Walworth Co., Inc., 60 E. 42nd, New York

**VALVES, BALANCED**

*Double-seated valve operated by some external force. Used for air, gas, steam, water or other fluids*

Beaird, J. B., Corp., Shreveport, La.

**Brown Instrument Co., Philadelphia, Pa.**

Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.

Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.

Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago

Dole Valve Co., 1913 Carroll Ave., Chicago

Foster Engineering Co., Newark, N. J.

General Controls Co., 1370 Harrison, San Francisco, Calif.

Hanna Engineering Works, 1765 Elston Ave., Chicago

Homestead Valve Mfg. Co., Corapolis, Pa.

Hydraulic Press Mfg., Co., Mt. Gilead, Ohio

Nathan Mfg. Co., 250 Park Ave., New York

Oilgear Co., Milwaukee, Wis.

Plouff Co., 1150 Columbus Ave., Boston, Mass.

**Racine Tool & Machine Co., Racine, Wis.**

Schutte & Koerting Co., Philadelphia, Pa.

Sumner Iron Wks, Everett, Wash.

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

**VALVES, CONTROL**

*Operating valves for hydraulic operated machinery*

American Engineering Co., Philadelphia, Pa.

Denison Engineering Co., 119 W. Chestnut, Columbus, Ohio

Oilgear Co., Bruce St., Milwaukee, Wis.

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

**VALVES, CONTROL, HAND OPERATED**

American Engineering Co., Philadelphia, Pa.

**Brown Instrument Co., Philadelphia, Pa.**

Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.

Crane Co., 836 S. Michigan Ave., Chicago

Detroit Lubrication Co., 5900 Trumbull Ave., Detroit, Mich.

Dole Valve Co., 1913 Carrol Ave., Chicago

Fairbanks Co., 393 Lafayette, New York

Hanna Engineering Works, 1765 Elston Ave., Chicago

Homestead Valve Mfg. Co., Corapolis, Pa.

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

Jenkins Bros., 80 White, New York

Kennedy Valve Mfg. Co., Elmira, N. Y.

Nicholson, W. H., Wilkes-Barre, Pa.

Parker Appliance Co., Cleveland, Ohio

Plouff Co., 1150 Columbus Ave., Boston, Mass.

Powell, Wm., Co., Cincinnati, Ohio

Q. C. Engineering Products, Detroit, Mich.

R-S Products Corp., Philadelphia, Pa.

Racine Tool & Machine Co., Racine, Wis.

Rockford Drilling Machine Co., Rockford, Ill.

Ross Operating Valve Co., Detroit, Mich.

Sumner Iron Wks., Everett, Wash.

Tompkins-Johnson Co., Jackson, Mich.

Vickers Inc., 1454 Oakman Blvd., Detroit, Mich.

Walworth Co., Inc., 60 E. 42nd, New York

**VALVES, CONTROL, SOLENOID OPERATED**

*For hydraulic actuated systems*

Atkins, E. C., & Co., Indianapolis, Ind.

Barber-Colman Co., Rockford, Ill.

Barnes, J. S., Corp., Rockford, Ill.

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee, Wis.

Denison Engineering Co., Columbus, Ohio

Electric Valve Mfg. Co., 68 Murray, New York

General Controls Co., 1370 Harrison, San Francisco, Calif.

**General Electric Co., Schenectady, N. Y.**

Homestead Valve Mfg. Co., Corapolis, Pa.

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

Nicholson, W. H., & Co., Wilkes-Barre, Pa.

Northern Pump Co., Minneapolis, Minn.

Oilgear Corp., Milwaukee, Wis.

Parker Appliance Co., Cleveland, Ohio

Partlow Corp., New Hartford, N. Y.

Penn Electric Switch Co., Goshen, Ind.

Plouff Co., 1150 Columbus Ave., Boston, Mass.

R-S Products Corp., Philadelphia, Pa.

**Racine Tool & Machine Co., Racine, Wis.**

Ross Operating Valve Co., Detroit, Mich.

Sundstrand Machine Tool Co., Rockford, Ill.

Tomkins-Johnson Co., Jackson, Mich.

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

Waterbury Tool Co., Waterbury, Conn.

**VALVES, DIAPHRAGM**

*Valve opened and closed by means of a diaphragm*

Bailey Meter Co., Cleveland, Ohio

Bastian Blessing Co., 240 E. Ontario, Chicago

Bristol Co., Waterbury, Conn.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Cash, A. W., Co., Decatur, Ill.

Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago

Dole Valve Co., 1913 Carroll Ave., Chicago

Fisher Governor Co., Marshalltown, Ia.

Foster Engineering Co., Newark, N. J.

General Controls Co., 1370 Harrison, San Francisco, Calif.

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

McCorkle Co., Berkeley, Calif.

Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Marsh, J. P., Corp., 2073 Southport Ave., Chicago

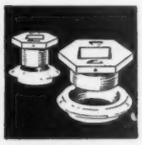
Parker Appliance Co., Cleveland, Ohio

**SPRING WASHERS**

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

**STEEL BARREL CLOSURES**

Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

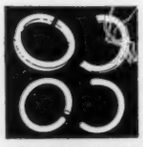


**STEEL ROD ENDS**

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

**CONTAINER HANDLES**

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.



**RETAINING RINGS**

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

**RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS**

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

*Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.*

**THE NATIONAL LOCK WASHER COMPANY**


*For further information on companies listed*

Partlow Corp., New Hartford, N. Y.

**Spencer Thermostat Co., Attleboro, Mass.**

Strong, Carlisle & Hammond Co., Cleveland, Ohio

Tagliabue, C J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.

Taylor Instrument Cos., Rochester, N. Y.

### VALVES, MOTOR OPERATED

*(See also Valves, Solenoid Operated)*

Automatic Temperature Control Co., Inc., 34 E. Logan, Philadelphia, Pa.

Barber-Colman Co., Rockford, Ill.

Bristol Co., Waterbury, Conn.

Brooke Engineering Co., 175 W. Huntington, Philadelphia, Pa.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.

Crane Co., 836 S. Michigan Ave,. Chicago

Cutler-Hammer, Inc., 315 N. 12th, Milwaukee. Wis.

Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago

Dickson Co., 7420 Woodlawn Ave., Chicago

Foster Engineering Co., 109 Monroe, Newark, N. J.

General Controls Co., 1370 Harrison, San Francisco, Calif.

**General Electric Co., Schenectady, N. Y.**

Jenkins Bros., 80 White, New York

Kennedy Valve Mfg. Co., Elmira, N. Y.

Partlow Corp., New Hartford, N. Y.

Parker Appliance Co., Cleveland, Ohio

Penn Electric Switch Co., Goshen, Ind.

Philadelphia Gear Wks., Philadelphia, Pa.

Powell, Wm., Co., Cincinnati, Ohio

R-S Products Corp., Philadelphia, Pa.

Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.

Taylor Instrument Cos., Rochester, N. Y.

Vaughan Motor Co., Portland, Ore.

Walworth Co., Inc., 60 E. 42nd, New York

### VALVES, PRESSURE REGULATING

*For reduction of initial high pressure to a desired service pressure*

Air Reduction Sales Co., 60 E. 42nd, New York

**Alemite Div., Stewart Warner Corp., 1826 Diversey Parkway, Chicago**

Bailey Meter Co., Cleveland, Ohio

Bastian Blessing Co., 240 E. Ontario, Chicago

Beaird, J. B., Corp., Shreveport, La.

Bristol Co., Waterbury, Conn.

Brooke Engineering Co., Inc., 175 W. Huntingdon, Philadelphia, Pa.

**Brown Instrument Co., Philadelphia, Pa.**

Buckeye Iron & Brass Works, 324 E. 3rd, Dayton, Ohio

Crane Co., 836 S. Michigan Ave., Chicago

Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago

Dole Valve Co., 1913 Carroll Ave., Chicago

Foster Engineering Co., Newark, N. J.

**Fulton Sylphon Co., Knoxville, Tenn.**

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

Linde Air Products Co., 205 E. 42nd, New York

McDonell & Miller, Wrigley Bldg., Chicago

Oilgear Co., Milwaukee, Wis.

Parker Appliance Co., Cleveland, Ohio.

Strong, Carlisle & Hammond Co., Cleveland, Ohio

Sumner Iron Wks., Everett, Mass.

Taylor Instrument Cos., Rochester, N. Y.

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

### VALVES, PRESSURE RELIEF

*For automatically releasing pressure of confined liquids or gases*

**Alemite Div., Stewart Warner Corp., 1826 Diversey Parkway, Chicago**

Ashton Valve Co., 161 First, Cambridge, Mass.

Bastian-Blessing Co., 240 E. Ontario, Chicago

Beaird, J. B., Corp., Shreveport, La.

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Buckeye Iron & Brass Works, 324 E. 3rd, Dayton, Ohio

Cochrane Corp., Philadelphia, Pa.

Crane Co., 836 S. Michigan Ave., Chicago

Crosby Steam Gage & Valve Co., Boston, Mass.

Davis Regulator Co., 2522 S. Washtenaw Ave., Chicago

Dole Valve Co., 1913 Carroll Ave., Chicago

Foster Engineering Co., Newark, N. J.

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

Johnston & Jennings Co., 877 Addison Rd., Cleveland, Ohio

Kennedy Valve Mfg. Co., Elmira, N. Y.

Lonergan, J. E. Co., Philadelphia, Pa.

Marsh, J. P., Corp., 2073 Southport Ave., Chicago

Oilgear Co., Milwaukee, Wis.

Parker Appliance Co., Cleveland, Ohio

Plouff Co., 1150 Columbus Ave., Boston, Mass.

**Racine Tool & Machine Co., Racine, Wis.**

Schutte & Koerting Co., Philadelphia, Pa.

Sherman, H. B., Mfg. Co., Battle Creek, Mich.

**Spencer Thermostat Co., Attleboro, Mass.**

Starr Brass Mfg. Co., Boston, Mass.

Tagliabue, C. J., Mfg. Co., 550 Park Ave., Brooklyn, N. Y.

United States Gauge Co., 44 Beaver, New York

Vickers, Inc., 1454 Oakman Blvd., Detroit, Mich.

### VALVES, THERMOSTAT

*Valve opened and closed by thermostat, used for temperature control.*

Barber-Colman Co., Rockford, Ill.

**Bristol Co., Waterbury, Conn.**

**Brown Instrument Co., 4459 Wayne Ave., Philadelphia, Pa.**

Dickson Co., 7420 Woodlawn Ave., Chicago

Dole Valve Co., 1913 Carroll Ave., Chicago

Electric Valve Mfg. Co., Inc., 68 Murray, New York

Foster Engineering Co., Newark, N. J.

**Fulton Sylphon Co., Knoxville, Tenn**

General Controls Co., San Francisco, Calif.

McCorkle, D. H., Co., Berkeley, Calif.

**Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**

Partlow Corp., New Hartford, N. Y.

Penn Electric Switch Co., Goshen, Ind.

Plouff Co., 1150 Columbus Ave., Boston, Mass.

**Spencer Thermostat Co., Attleboro, Mass.**

Taylor Instrument Cos., Rochester, N. Y.

### VIBRATION DAMPENERS

*For vibrationless mounting of motors, machines, units or parts.*

Dayton Rubber Mfg. Co., Dayton, Ohio

Firestone Tire & Rubber Co., Akron, Ohio

Goodrich, B. F., Co., Akron, Ohio

Korfund Co., 32nd Place, Long Island City, N. Y.

Lord Mfg. Co., Erie, Pa.

Synthane Corp., Oaks, Pa.

U. S. Rubber Products, Inc., 1790 Broadway, New York

Vibration Eliminator Co., 2508-37th St., Long Island City, N. Y.

### VOLTMETERS

Bristol Co., Waterbury, Conn.

Clough-Brengle Co., 2815 W. 19th, Chicago

Engelhard, C., Inc., 90 Chestnut, Newark, N. J.

**General Electric Co., Schenectady, N. Y.**

Norton Electric Instrument Co., Manchester, Conn.

Reliance Instrument Co., 1135 W. Van Buren, Chicago

Roller-Smith Co., 233 Broadway, New York

Sensitive Research Instrument Co., 4545 Bronx Blvd., New York

Triplett Electric Instrument Co., Bluffton, Ohio

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Weston Electrical Instrument Corp., Newark, N. J.

### WASHERS

*For small brass or copper washers (burrs) see Rivets, Brass and Copper.*

### WASHERS, FELT

*(See Felt Parts)*

### WASHERS, LOCK

Atlas Bolt & Screw Co., 1130 Ivanhoe Rd., Cleveland, Ohio

**Barnes, Wallace, Div. Associated Spring Corp., Bristol, Conn.**

Beall Tool Div., Hubbard & Co., East Alton, Ill.

*in bold face type, see index on last page*

Specified for
REMOTE
CONTROL
TRU·LAY
PUSH-PULL CONTROLS
● TRU-LAY Push-Pull Controls may be specified with confidence for remote control operations in any type of equipment.
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CONSULT US ON YOUR REMOTE CONTROL PROBLEMS
In Business for Your Safety
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**WASHERS, LOCKS (Con't)**

Butcher & Hart Mfg. Co., Toledo, Ohio

Dunbar Bros., Div. Associated Spring Corp., Bristol, Conn.

Eaton Mfg. Co., Massillon, Ohio

Eaton Mfg. Co., Cleveland, Ohio

Harper, H. M., Co., 2620 Fletcher, Chicago

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

Keystone Gasket Mfg. Co., 831 N. 4th, Philadelphia, Pa.

**National Lock Washer Co., Newark, N. J. and Milwaukee, Wis.**

National Machine Products Co., Detroit, Mich.

Oliver Iron & Steel Co., Pittsburgh, Pa.

Palnut Co., Irvington, N. J.

Positive Lock Washer Co., Newark, N. J.

Rawlplug Co., Inc., 98 Lafayette, New York

Rockford Bolt & Steel Co., Rockford, Ill.

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Shakeproof Lock Washer Co., 2525 N. Keeler Ave., Chicago

SKF Industries, Inc., Philadelphia, Pa.

St. Louis Screw & Bolt Co., St. Louis, Mo.

**Thompson-Bremer & Co., 1640 W. Hubbard, Chicago**

United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio

Wrought Washer Mfg. Co., Milwaukee, Wis.

**WASHERS, STEEL PLATE**

Bayonne Bolt Corp., Bayonne, N. J.

Bethlehem Steel Co., Bethlehem, Pa.

Bossert Corp., Utica, N. Y.

Chicago-Wilcox Mfg. Co., 7701 Avalon Ave., Chicago

Central Iron & Steel Co., Harrisburg, Pa.

Clark Bros. Bolt Co., Milldale, Conn.

Crosby Co., 183 Pratt, Buffalo, N. Y.

Goetze Gasket & Packing Co., New Brunswick, N. J.

Detroit Stamping Co., 3445 W. Fort, Detroit, Mich.

Griffin Mfg. Co., Erie, Pa.

Haskell, Wm. H., Mfg. Co., 24 Commerce, Pawtucket, R. I.

Hubbard, M. D., Spring Co., Pontiac, Mich.

Lansing Stamping Co., Lansing, Mich.

Lukens Steele Co., Coatesville, Pa.

New England Bolt Co., Inc., Everett, Mass.

Pheoll Mfg. Co., Roosevelt Road, Chicago

Republic Steel Corp., Cleveland, Ohio

Rockford Bolt & Steel Co., Rockford, Ill.

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

Ryerson, Joseph T., & Sons, Inc., Buffalo N. Y.

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Sessions, J. H., & Son, Bristol, Conn.

Stanley Works, New Britain, Conn.

St. Louis Screw & Bolt Co., St. Louis, Mo.

Sumner Iron Wks., Everett, Mass.

United Screw & Bolt Corp., 3590 W. 58th, Cleveland, Ohio

U. S. Indestructible Gasket Co., 829 E. 15th, Brooklyn, N. Y.

Wrought Washer Mfg. Co., Milwaukee, Wis.

Youngstown Pressed Steel Co., Warren, Pa.

**WHEELS**

*With or without rubber tires*

American Car & Foundry Co., 30 Church, New York (cast type)

American Manganese Steel Div., American Brake Shoe & Foundry Co., 389 E. 14th, Chicago Heights, Ill. (cast type)

Bassick Co., Bridgeport, Conn. (casters and pressed wheels)

Erie Malleable Iron Co., Erie, Pa. (cast type)

Jarvis & Jarvis, Inc., Palmer, Mass.

**Link-Belt Co., 2410 W. 18th, Chicago (cast type)**

**Musselman Products Co., 6308 St. Clair Ave., Cleveland, Ohio (pneumatic tires and wheels for portable machinery)**

**WATTHOUR METERS**

General Electric Co., Schenectady, N. Y.

***For further information on companies listed***

Sangamo Electric Co., Springfield, Ill.

**WELDING ROD**
*(see Wire, Welding)*

**WIRE, ALLOY STEEL, ROUND**

Allegheny Steel Co., Brackenridge, Pa.

**American Steel & Wire Co., Cleveland, Ohio**

Bethlehem Steel Co., Bethlehem, Pa.

Bissett Steel Co., Cleveland, Ohio

**Carpenter Steel Co., Reading, Pa.**

**Columbia Steel Co., U. S. Corp. Sub., San Francisco, Calif.**

Crucible Steel Co. of America, 405 Lexington Ave., New York

Eaton Mfg. Co., Massillon, Ohio

Halcomb Steel Co., Syracuse, N. Y.

LaSalle Steel Co., Palmolive Bldg., Chicago

Ludlum Steel, Co., Watervliet, N. Y.

Moltrup Steel Products Co., Beaver Falls, Pa.

Monarch Steel Co., Indianapolis, Ind.

New England High Carbon Wire Co., Millbury, Mass.

Republic Steel Corp., Cleveland, Ohio

**Rustless Iron & Steel Corp., Baltimore, Md.** (Stainless)

Seneca Wire & Mfg. Co., Fostoria, Ohio

Timken Steel & Tube Co., Canton, Ohio

**United States Steel Corp., 71 Broadway, New York**

Universal-Cyclops Steel Corp., Bridgeville, Pa.

Wheeling Steel Corp., Wheeling, W. Va.

Wickwire Spencer Steel Co., 41 E. 42nd, New York

**WIRE CABLE OR ROPE, STEEL**

**American Chain & Cable Co., 12–252 General Motors Bldg., Detroit, Mch.**

**American Steel & Wire Co., Cleveland, Ohio.**

**Columbia Steel Co., U. S. Steel Corp. Sub., San Francisco, Calif.**

Hazard Wire Rope Co., Wilkes Barre, Pa.

Leschen, A., & Sons Rope Co., St. Louis, Mo.

Macwhyte Co., Kenosha, Wis.

Rochester Ropes, Inc., Jamaica, New York

Roebling's, John A., Sons Co., Trenton, N. J.

Ryerson, Joseph T., & Son, Inc., 2558 W. 16th, Chicago

Wickwire Spencer Steel Co., 41 E. 42nd, New York

**WIRE, CARBON STEEL, ROUND**

Air Reduction Sales Co. 60 E. 42nd, New York

**American Steel & Wire Co., Cleveland, Ohio**

Bethlehem Steel Co., Bethlehem, Pa.

Bissett Steel Co., Cleveland, Ohio

Crucible Steele Co. of America, 405 Lexington Ave., New York

**Columbia Steel Co., U. S. Steel Corp., San Francisco, Calif.**

Eaton Mfg. Co., Massillon, Ohio

Halcomb Steel Co., Syracuse, N. Y.

Igoe Brothers, Inc., 73 Metropolitan Ave., Brooklyn, N. Y.

Inland Steel Co., First National Bank Bldg., Chicago

Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Ludlum Steel Co., Watervliet, N. Y.

Moltrup Steel Products Co., Beaver Falls, Pa.

Monarch Steel Co., Indianapolis, Ind.

New England High Carbon Wire Co., Millbury, Mass.

Pittsburgh Steel Co., Pittsburgh, Pa.

Republic Steel Corp., Cleveland, Ohio

Roebling's, John A., Sons Co., Trenton, N. J.

Ryerson, Joseph T., & Son, 2558 W. 16th, Chicago

Seneca Wire & Mfg. Co., Fostoria, Ohio

Timken Steel & Tube Co., Canton, Ohio

**United States Steel Corp., 71 Broadway, New York**

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*in bold face type, see index on last page*


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Cleveland Wire Cloth & Mfg. Co., Cleveland, Ohio

Conklin, T. E., Brass & Copper Co., 76 Lafayette, New York

Cosgrove Wire Cloth Co., Belleville, N. J.

Gilbert & Bennett Mfg. Co., Georgetown, Conn.

Jelliff Mfg. Corp., Southport, Conn.

Ludlow-Saylor Wire Co., St. Louis, Mo.

Newark Wire Cloth Corp., Newark, N. J.

Phoenix Wire Wks.. 1940 E. Kirby Ave.. Detroit, Mich.

Roebling's, J. A., Sons Co., Trenton, N. J.

Seneca Wire & Mfg. Co., Fostoria, Ohio

Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York (resistance-silk insulated)

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**General Plate Co., 40 Forest, Attleboro, Mass.**

Pittsburgh Steel Co., Pittsburgh, Pa.

Republic Steel Corp., Cleveland, Ohio

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Seneca Wire & Mfg. Co., Fostoria, Ohio

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Wickwire Spencer Steel Co., 41 E. 42nd, New York

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Baker & Co., Inc., 113 Astor, Newark, N. J.

**General Plate Co., 40 Forrest, Attleboro, Mass.**

Goldsmith Bros. Smelting & Refining Co., 58 E. Washington, Chicago

Handy & Harman, 82 Fulton, New York

**Wilson, H. A. Co., Newark, N. J.**

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Baker & Co., Inc., 113 Astor, Newark, N. J.

Bishop, J., & Co., Platinum Works, 12 Channing Ave., Malvern, Pa.

Bissett Steel Co., Cleveland, Ohio

Crucible Steel Co. of America, 405 Lexington Ave., New York

Driver, Wilbur B., Co., 150 Riverside Avenue, Newark, N. J.

Eagle Electric Mfg. Co., Inc., 59-79 Hall, Brooklyn, N. Y.

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Phoenix Wire Wks., 1940 E. Kirby Ave, Detroit, Mich.

Roebling's, John A., Sons Co., Trenton, N. J.

Seneca Wire & Mfg. Co., Fostoria, Ohio

Stephens-Adamson Mfg. Co., Aurora, Ill.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J. (Manganese steel)

United Metals, Spokane, Washington

Wickwire Spencer Steel Co., 41 E. 42nd, New York

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Eaton Mfg. Co., Massillon, Ohio

**General Plate Co., 40 Forrest, Attleboro, Mass.**

Morse Chain Co., Ithaca, N. Y.

New England High Carbon Wire Co., Millbury, Mass.

Phoenix Wire Wks., 1940 E. Kirby Ave. Detroit, Mich.

Pittsburgh Steel Co., Pittsburgh, Pa.

Roebling's, John A., Sons Co., Trenton, N. J.

Seneca Wire & Mfg. Co., Fostoria, Ohio

Universal-Cyclops Steel Corp., Bridgeville, Pa.

Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio

Wickwire Spencer Steel Co., 41 E. 32nd, New York

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Eaton Mfg. Co., Massillon, Ohio

**General Plate Co., 40 Forrest, Attleboro Mass.**

Jones & Laughlin Steel Corp., Pittsburgh, Pa.

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Riverside Metal Co., Riverside, N. J.

Roebling's, John A., Sons Co., Trenton, N. J.

Seneca Wire & Mfg. Co., Fostoria, Ohio

Universal-Cyclops Steel Corp., Bridgeville, Pa.

Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio

Wickwire Spencer Steel Co., 41 E., 42nd, New York

### WIRE, WELDING

Air Reduction Sales Co., 60 E. E. 42nd, New York

Allegheny Steel Co., Brackenridge, Pa.

**American Steel & Wire Co., Cleveland, Ohio**

Bastian-Blessing Co., 240 E. Ontario, Chicago

**Bridgeport Brass Co., Bridgeport, Conn.**

Chicago Hardware Foundry Co., North Chicago, Ill.

**Columbia Steel Co., U. S. Steel Corp. Sub., San Francisco, Calif.**

Crucible Steel Co. of America, 405 Lexington Ave., New York

Lincoln Electric Co., Cleveland, Ohio

Linde Air Products Co., E. 42nd, New York

Mallory, P. R., & Co., Indianapolis, Ind.

Page Steel & Wire Co., Monessen, Pa.

Republic Steel Corp., Cleveland, Ohio

Revere Capper & Brass Inc., 230 Park Ave., New York

Roebling's J. A., Sons Co., Trenton, N. J.

Ryerson, Joseph T., & Son, 2558 W. 16th, Chicago

Wickwire Spencer Steel Co., 41 E. 42nd, New York

**General Electric Co., Schenectady, N. Y.**

Hoskins Mfg., Co., 445 Lawton Ave., Detroit, Mich.

Imperial Brass Mfg. Co., 1200 W. Harrison, Chicago

McKay Co., Pittsburgh, Pa.

Metal & Thermit Corp., 120 Broadway, New York

Pittsburgh Steel Co., Pittsburgh, Pa.

Riverside Metal Co., Riverside, N. J.

**Rustless Iron & Steel Corp., Baltimore, Md.**

Scully Steel Products Co., 1319 Wabansia Ave., Chicago

Seneca Wire & Mfg. Co., Fostoria, Ohio

Stoody Co., Whittier, Calif.

Taylor Wharton Iron & Steel Co., High Bridge, N. J., (nickel manganese steel)

Universal-Cyclops Steel Corp., Bridgeville, Pa.

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***For further information on companies listed***

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Eaton Mfg. Co., Reliance Spring Washer Div., Massilon, Ohio

Grammes, L. F., & Sons, Inc., Allentown, Pa.

Standard Spring & Mfg. Co., Inc., 236-42nd St., Brooklyn, N. Y.

Tichenor, E. H., & Co., Binghamton, N. Y.

Western Wire Products Co., St. Louis, Mo.

Wickwire Spencer Steel Co., 41 E. 42nd, New York

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**WIRE ROPE, STEEL**

(*see Wire Cable*)

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Appollo Metal Works, 6601 S. Oak Park Ave., Chicago

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New Jersey Zinc Co., 160 Front St., New York

**Du Pont de Nemours & Co., Inc., Wilmington, Del.**

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Long, W. H., Co., 420 N. Clark, Chicago

Paragon-Revolute Corp., Rochester, N. Y.

Pease, C. F., C. O., 2684 W. Irving Pk. Rd., Chicago

Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York

Twomley, H. E., 7154 Magnolia Ave., Riverside, Calif.

Weber, F., Co., Inc., Philadelphia, Pa.

Wright, L. G., Inc., Cleveland, Ohio

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**Brown, E. S., 78 Standard Ave., Auburn, N. Y.** (Combination protector triangle)

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**Bruning, Chas., Co., 102 Reade St., New York**

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Gurley, W. & L. E., Troy, N. Y.

Integraph Co., Forest Hill, East Cleveland, Ohio (Integrator)

**Keuffel & Esser, Hoboken, N. J.**

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Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York

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Technical Supply Co., Scranton, Pa.

Wade Instrument Co., Cleveland, Ohio

Weber, F., Inc., Philadelphia, Pa.

Williams, Brown & Earle, Philadelphia, Pa.

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***in bold face type, see index on last page***


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Wright, L. G., Co., Cleveland, Ohio

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Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York

Technical Supply Co., Scranton, Pa.

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Weber, F., Co., Philadelphia, Pa.

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Dietzgen, Eugene, Co., 2425 Sheffield Ave., Chicago

Higgins, Chas. M., 271-9th St., Brooklyn, N. Y.

**Keuffel & Esser, Hoboken, N. J.**

Pease, C. F., Co., 2684 W. Irving, Pk. Rd., Chicago

Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York

Stafford, S. S., Inc., 607 Washington, New York

Weber, F. Co., Inc., Buttonwood, Philadelphia, Pa.

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American Pencil Co., Hoboken, N. J.

Bartusch, A. P., 775 Walnut, Lockport, N. Y.

Blaisdell Pencil Co., Philadelphia, Pa.

Dietzgen, Eugene, Co., 2425 Sheffield Ave., Chicago

Dixon, Joseph, Crucible Co., Jersey City, N. J.

**Eagle Pencil Co., 703 E. 13th, New York**

Faber, A. W., Inc., Newark, N. J.

Faber, Eberhard, 37 Greenpoint Ave., Brooklyn, N. Y.

General Pencil Co., Jersey City, N. J.

**Keuffel & Esser Co., Hoboken, N. J.**

Kohinoor Pencil Co. Inc., 375-4th Ave., New York

Sensitive Research Instrument Corp., 4545 Bronx Blvd., New York

Staedtler, J. S., Inc., 53 Worth, New York

Weber, F., Co., Philadelphia, Pa.

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Pease, C. F., Co., 2684 W. Irving Pk. Rd., Chicago

Photostat Co., Providence, R. I.

Shaw Blue Print Machine Co., Newark, N. J.

Smith, F. A., Mfg. Co., Inc., Rochester, N. Y.

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***For further information on companies listed in bold face type, see index on last page***

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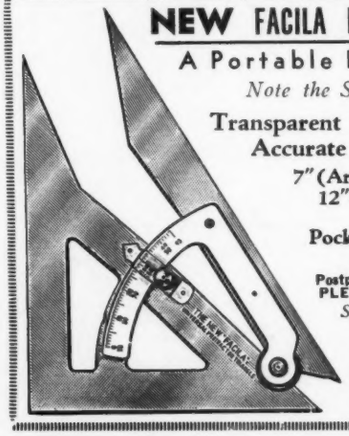

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Scovill offers the facilities of its well established Canadian plant in Toronto, Ontario, to those concerns interested in distributing to Canadian and foreign markets.

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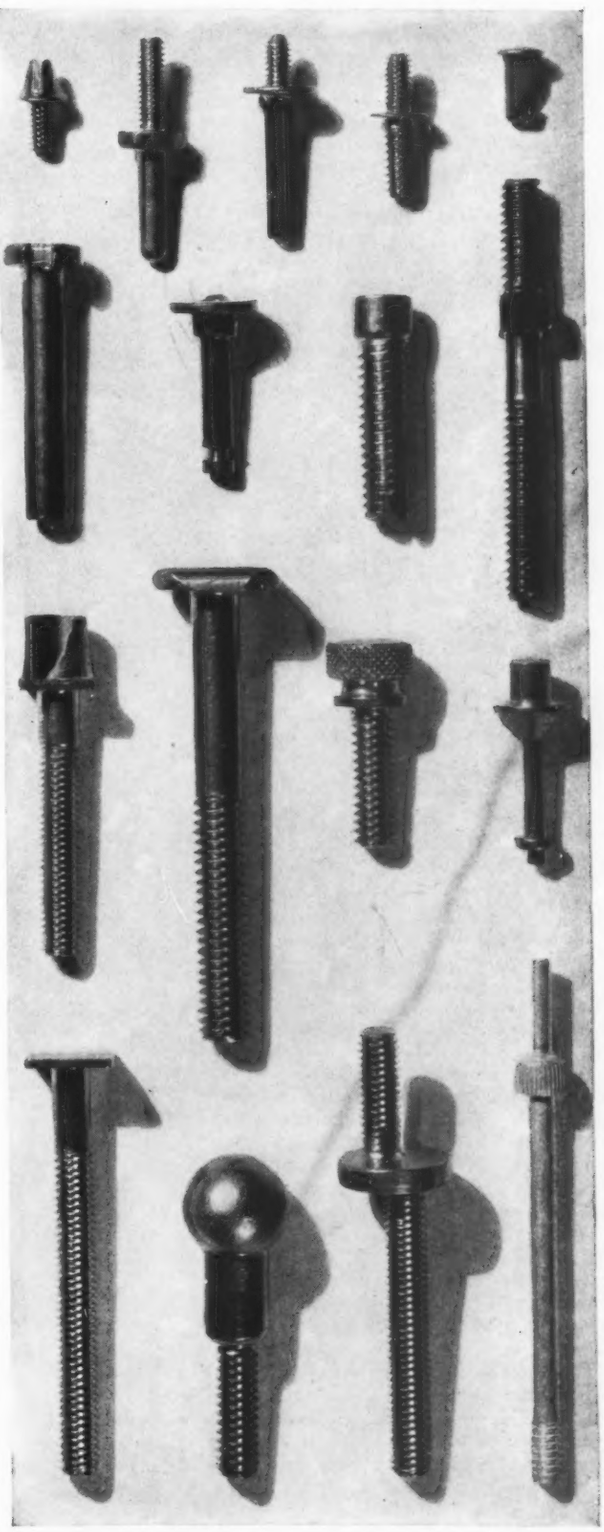
A letter to Scovill at either Waterbury or Toronto will bring you further information.



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ABOUT OUR

# AUTHORS AND CONTRIBUTORS

## He Counts the Cost

An authority on the design of drop forgings, L. E. Scrannage, general superintendent of The Cleveland Hardware & Forging Company, is kept too busy to write articles. But we were lucky to catch him when he had time for an interview. He also is a two-college man, Tufts and M.I.T. After serving in the forging division of Remington Arms, he was appointed to the auditing and engineering staff of Scovill Wellington Company. But he was soon called to do war duty at the Philadelphia Navy Yard as shop superintendent. Following the war he resumed industrial engineering at the Sheldon Axle Works, the Willys Overland Company, the Toledo Machine & Tool Company, and in 1929 joined the staff of the Trundle Engineering Company. Since 1934 he has been operating superintendent of The Cleveland Hardware & Forging Company. His wide industrial experience in management, accounting, budgetary control, standard costs, design and plant operation explain his broad views on engineering problems. His analysis of streamlined design of drop forgings appearing on page 16 reflects the many angles from which he views the design problem. He is a member in all five branches of the American Management Association, member of the cost committee of the Drop Forgers Association and member of the Editorial Advisory Board of the National Foreman's Institute, Inc.

L. E. SCRANNAGE

## Attorney and Engineer

Patent attorney of national reputation, Col. H. A. Toulmin, Jr. has contributed numerous articles to *P.E.* and writes the regularly appearing feature, Case Histories in Patent Law. His degrees include B.A. from University of Virginia, J.D. from Ohio State and the honorary degrees of L.L.D. and Lit.D. He was admitted to the Ohio Bar in 1913, later to the United States Courts, and to the Bar of the Supreme Court of the United States in 1919. He is a member of the firm of Toulmin & Toulmin of Dayton, Ohio, attorneys specializing in patent, trade mark, fair trade and corporation causes.

During the World War, Col. Toulmin served first with the Council of National Defense, then with the U. S. Army Air Corps in France, and was awarded the U. S. Distinguished Service Medal. He is now reserve Colonel of Engineers. His interest in engineering led him into extensive researches in steam, refrigeration and measuring instruments with the result that he has been granted about a dozen patents on such diverse inventions as shock absorbers, liquid level gauges, belts, lenses and water softening apparatus.

Col. Toulmin, in addition to his numerous articles appearing in the business and technical press has written eight books, among them Invention and the Law, Executives Business Law, Patent Law for the Inventor and Executive, and Trade Mark Profits and Protection. His society memberships include Franklin Society, American Chemical Society, A.S.M.E., S.A.E., A.W.S., the Royal Economic Society (England) and the American Society of Military Engineers.

COL. H. A. TOULMIN, JR.

L. H. FROST

## An Authority on Welding

L. H. Frost is being initiated into technical writing with his series of articles on resistance welding beginning in this number of *P.E.* He stated, "As a result of my experiences in the development of electrical controls for resistance welding machines, I got the idea of writing a series of articles dealing with the practical end." and that is why we induced him to write the articles for *P.E.*

After getting his B.S.E.E. from Syracuse University, Mr. Frost spent four years on mechanical design, hydraulics and compressed air. Then he took up the design of electrical controls, covering not only motor controls but practically every apparatus for which electric controls are built, including resistance welding. This led him into researches into the fundamental principles of resistance welding and the construction of all types of resistance welding machines. He covered the whole range of these welding machines, from those that weld a wire as fine as a human hair to those that weld fence posts or automobile bodies.

Mr. Frost's reputation as an authority on resistance welding resulted in him being invited to lecture on the subject at Purdue and Ohio State universities and to present papers before various technical societies. At the Electric Controller & Manufacturing Company he has the title of welding engineer and specializes in the development of controls for resistance welders.

## What's It All About

Frequently in our travels and personal contacts with our readers we are asked who this or that contributor is, what he looks like, how old he is and numerous similar questions. And thus it has come about that we have added this human interest page which will appear each month as a regular feature.

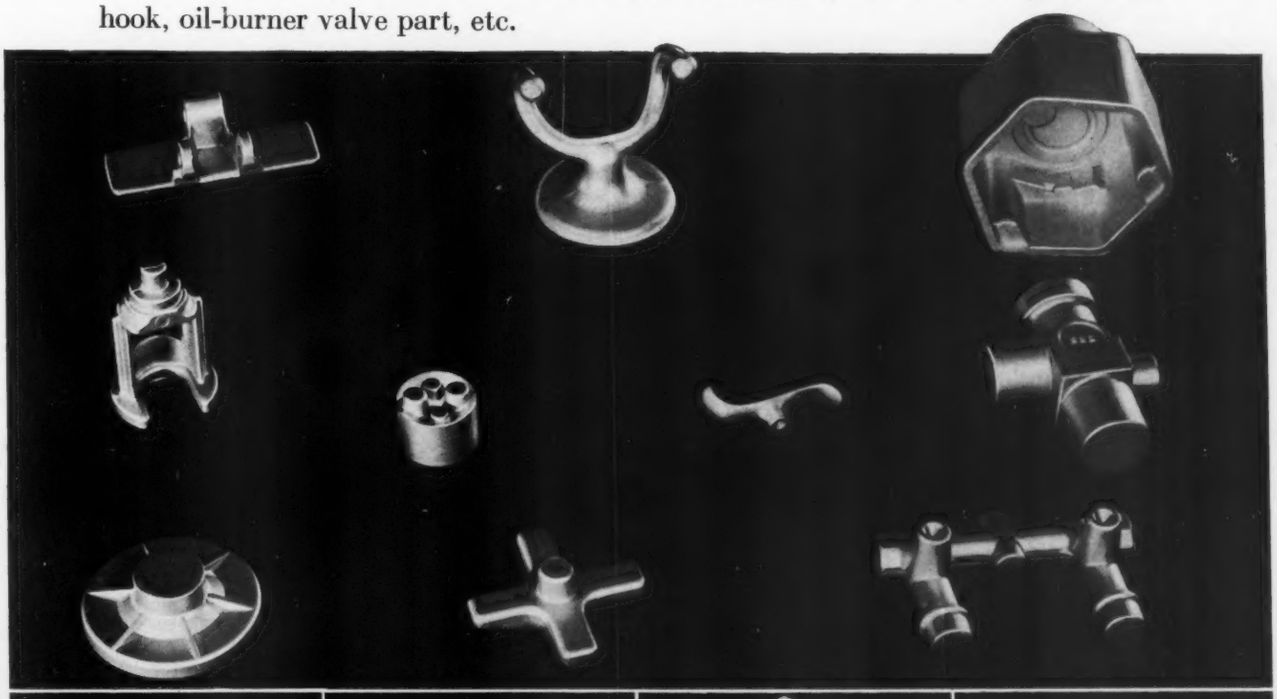
Space does not permit us to cover every contributor to each issue. Authors of series of articles will be presented once. Thus we hope to cover all.

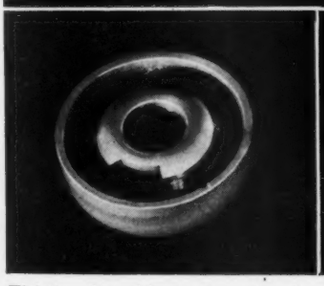
Next month we will introduce you to Jack Delmonte, author of the series of articles on cleaning and chemical coatings, beginning in this number; Waldemar Naujoks, chief engineer of The Steel Improvement & Forging Company; F. H. Johnson, who will have an article on plastic molding; and G. T. Williams of Cleveland Tractor Company who has contributed to our drop forgings articles.

# The Anvil Rings

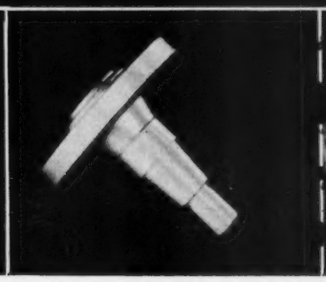
But in this Twentieth Century, the Smith is a forging press operator and his anvil is his press. At Scovill, forgings from brass, bronze, copper and aluminum are produced in hundreds of made to order shapes and sizes. They can be supplied just as they come from the dies . . . or machined and finished by polishing and plating — ready for assembly.

Smoother than castings, forgings have greater density, are accurate to size . . . save on machining costs. Below are airplane oil filter part, armature part, robe hook, oil-burner valve part, etc.



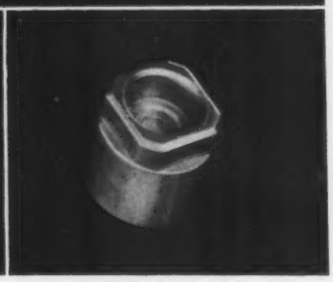


*This beer barrel bung is an aluminum forging. There is a recession under the inside lip which allows the lip to act as a locking flange. This is a difficult but quite practical Scovill job.*



*This is a combination of a brass forging and a steel insert. The brass is finish-forged around the steel insert, producing — for all practical purposes — a single inseparable unit. Scovill forging skill here saves the customer money.*

*These three lock parts once were cast. Scovill forging eliminated cleaning, grinding and cold stamping operations, plus two milling operations. And the cleaner, nonporous, free from sand occlusion forgings caused less wear on tools. Result: The manufacturer saves 12% on his complete lock.*



*As a casting, this part required four separate, expensive finishing operations. Forged of brass at Scovill, it was finished to such a high degree of precision that only one extra operation was necessary to complete it. And the manufacturer saves 20%.*

**For further information write direct to 35 Mill St., Waterbury, Conn., or to any Scovill branch listed below**

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ABOUT OUR

# AUTHORS AND CONTRIBUTIONS

**Joseph Marin** contributes his third article to *Product Engineering* in this number. Many of our readers will remember his two articles on working stresses which appeared last year.

The theories of failure of materials subjected to combined stresses are still in the formative stage. Professor Marin has done much to show the apparent agreement between available test observations and proposed theories.

Professor Marin holds engineering degrees from three universities, the University of British Columbia, the University of Illinois, and the University of Michigan. His practical experience is broad. He has held positions with the Geological Survey of Canada, the Bylesby Engineering and Management Corporation, and the Westinghouse Electric & Mfg. Company. His teaching career at Rutgers began in 1930 with the position of instructor in civil engineering; he is now assistant professor of engineering materials at that university. He is a member of the following engineering societies, A.S.C.E., A.S.M.E., A.S.T.M., A.C.I. and the S.P.E.E.

**Henry O. Fuchs** after studying at several European schools served an apprenticeship at the Schaerer Machine Tool Works, Karlsruhe, Baden, and later was graduated from the Karlsruhe Engineering College.

After some time with the A. G. Horchwerke Company of Berlin, a manufacturer of automobiles, as processing engineer Dr. Fuchs returned to Karlsruhe Engineering College to engage in shock absorber research and specialized in suspension and vibration problems.

Since 1933 Dr. Fuchs has been with the General Motors Corporation, at first with the Delco Products Division developing shock absorbers for electric motors and later became engaged in product studies.

In addition to contributing an article to *Product Engineering* in August 1936, on "Spiral Diagrams to Solve Vibration Damping Problems," Dr. Fuchs has written technical articles for *Automobiltechnische — Zeitschrift* (Berlin), *Frankfurter Zeitung* (Frankfurt), and *Automotive Industries.*

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## Wrong Geography and History

*To the Editor:*

In your editorial in the June number there are two glaring errors which I hope you will correct before "Olie Hansen" starts yelping.

1. Frederick the Great was a king of Prussia.

2. Jena is not in Switzerland, but in Germany. —E.V.

*Detroit, Mich.*

*To the Editor:*

I heartily commend your editorial "What Has Been Done Can Be Done Again," appearing in the June number of *Product Engineering.* The thought back of this editorial is so well expressed by it that it cannot fail to strike a responsive chord throughout industry, and I believe in financial circles as well.

One thing we must all realize, and that is that engineering brains have created the great industries, and not the reverse. What has been done can be better done again, and will be done just as soon as trained engineers take the initiative, supply the incentive and win the confidence and backing of capitalists and financiers in different sections of our land.

—B. D. W.

*Oak Park, Ill.*

*To the Editor:*

Wonder if "Olie Hansen" will cry "politics" about your editorial in the June number. I liked it and I think that it presented one phase of the work of the engineers that is not generally recognized or appreciated. More power to you. —A. F.

*Philadelphia, Pa.*

*To the Editor:*

Your editorial in the June issue of *Product Engineering* is very interesting in that it brings out some historical, as well as geographical facts little known to most engineers.

I had always thought that Frederick the Great was King of Prussia and never knew about his promotion to Emperor of Germany until I read your editorial.

The last time I passed through Jena, it was in Thuringia, Germany, but then that was fifteen years ago so they must have moved to Switzerland since.

Well, we live and learn. —K. C. N.

*Erie, Pa.*

[Editor's Note: We humbly confess to the errors referred to above in that Wilhelm I was the first emperor of Germany and Jena is in Germany. Evidently these errors do not entirely destroy the editorial and we are appreciative of the expression of commendation for the aim of the editorial.

In answer to A. F., "Olie Hansen" has not cried politics and we did our best to present the thoughts expressed without giving them a political flavor. To our minds it is not a question of politics but a problem of mass thinking and psychology.]

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## Cost Comparisons

Quite a number of readers have suggested that we have articles that deal with relative costs. That is difficult to do because of the many variable factors that enter into any cost problem. Also it is rare to find examples from which cost figures can be obtained. Usually, when a change is made, the two costs are not comparable because the designs are changed completely.

However, we commissioned Herbert Chase, known to many of our readers, to develop an article giving a comparison of the advantages, limitations and cost of stamping versus die-castings. He secured actual cost figures from a number of companies of comparable designs of stamped and die-cast parts. Thus Mr. Chase developed an outstanding article for our August number.

## They Will Debate the Subject

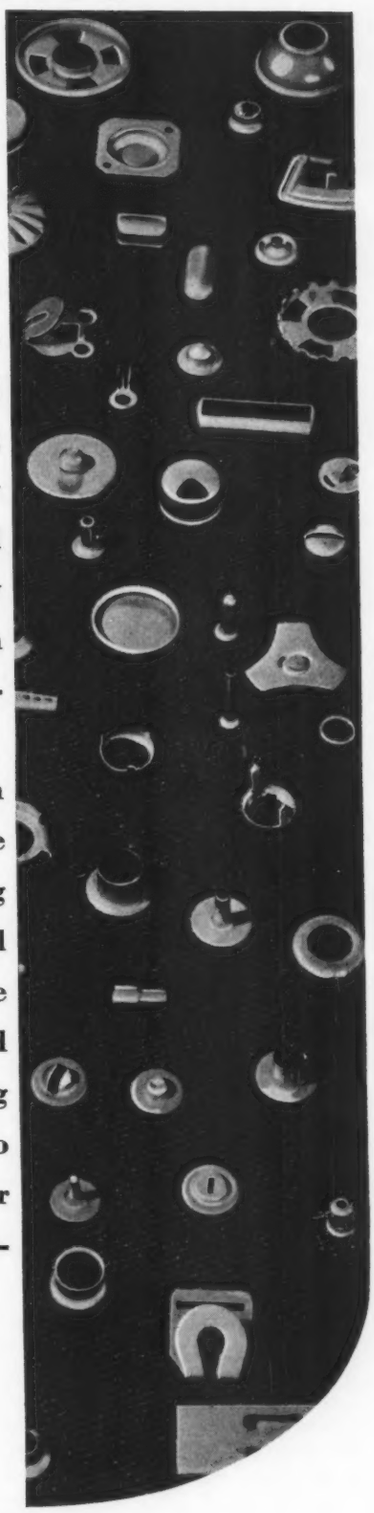
What'll it be—standard motor or special motor? In many designs there is no question as to which it should be. But there are also many applications that fall close to the borderline and grave doubts arise as to whether a standard motor should be used or whether it will pay to call for a special motor. So we induced Mr. C. T. Button, sales engineer of the Holtzer-Cabot Electric Company, to present the case for the special motor and Mr. C. M. Sayre, assistant manager of small motors sales of the Westinghouse Electric & Mfg. Company, to present the case for the standard motor.

Each of these men reviewed the manuscript of the other. In the August number we will introduce Mr. Button and will present his article "Special Motors —When and Why to Use Them." September *Product Engineering* will present Mr. Sayre's analysis of the reasons for using standard motors.

# These Little Pieces are Death . . .

. . . to high production costs. For these automatically made small metal products we receive orders requiring the use of practically every base metal. Some are partially finished, others complete. Some we assemble ourselves into the finished product. Some we plate or enamel and ship to the customer — ready for him to assemble into his finished product. This latter case is frequently true because Scovill facilities often permit exceptional production economies.

Whether you need a part for an electrical device, a flashlight, a fire extinguisher, cameras, or anything else of metal, remember that Scovill now manufactures to order some three hundred thousand parts and products . . . that Scovill engineering skill, economy, and quality go into every job. Write today to one of our offices, or to 35 Mill Street, Waterbury, Connecticut.



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ABOUT OUR

# AUTHORS AND CONTRIBUTORS

**Otto W. Fisher,** who furnished the design data on which this month's article, "Better Welded Design", was developed, was graduated from German Technological College in Czechoslovakia.

After obtaining practical shop experience in the Skoda Works, Pilsen, he came to the United States and spent several years as production and design engineer with Nathan Manufacturing Company and then as designer with the

OTTO W. FISHER

Babcock and Wilcox Company and the Federal Storage Battery Company.

His experience in sanitary equipment design dates from the formation of the firm of Furman-Fisher Corporation, organized to design and manufacture milk machinery and special equipment. L. O. Koven and Brother offered him in 1921 the position of chief engineer in charge of design and shop management. In 1929 he was elected to his present position of vice-president of that concern.

**Herbert Chase,** author of the article, "Die-Cast or Stamped," is a former associate editor of *Product Engineering* and of *American Machinist*. He is author of the book, "Die Castings" and of numerous magazine articles and has presented many papers before various engineering societies, including the Society of Automotive Engineers, of which he has been an active member for more than 25 years, many of them as an officer. Now an independent engineering consultant, he still devotes much time to writing for many American and British engineering and industrial publications, especially on metal-working, die casting, plastics, production and automotive subjects.

Besides the connections mentioned above, Mr. Chase has served as chief engineer of the Automobile Club of

HERBERT CHASE

America, where he had charge of a large automotive testing laboratory. He also was engineering editor of "Automotive Industries." During the world war he was assistant secretary of the Society of Automotive Engineers in charge of its Washington office and served on various government committees dealing with automotive engineering problems. He is a graduate in mechanical engineering of Sibley College, Cornell University, class of 1908.

**Trescott S. White** who contributed the W $R^2$ tables that appear on the Reference Book Sheet pages in this number, is a native Californian. He mixed practical experience with education in theory for a few years after graduating from high school; part of the time he was a sheet metal worker and part of the time a student at San Diego State College. Then followed several years full time work at the Air Corp's engine repair shops at San Diego, another year at junior college and finally two years at the University of California which in 1934 gave him the degree B.S. in Mechanical Engineering.

During the past 4 years, Trescott White has been in the engineering department of the Enterprise Engine Com-

TRESCOTT S. WHITE

pany, his specialty just now being torsional analysis. He is a member of the Society of Automotive Engineers.

**C. T. Button** ably describes for our readers, in this issue, the field for and the advantages that can be obtained by using special motors. It is the first article of his that *Product Engineering* has had the privilege of presenting.

Mr. Button received the degree of Electrical Engineer from the University of Cincinnati. While he was with the Union Gas & Electric Company at Cincinnati, Ohio, he was engaged in power engineering work.

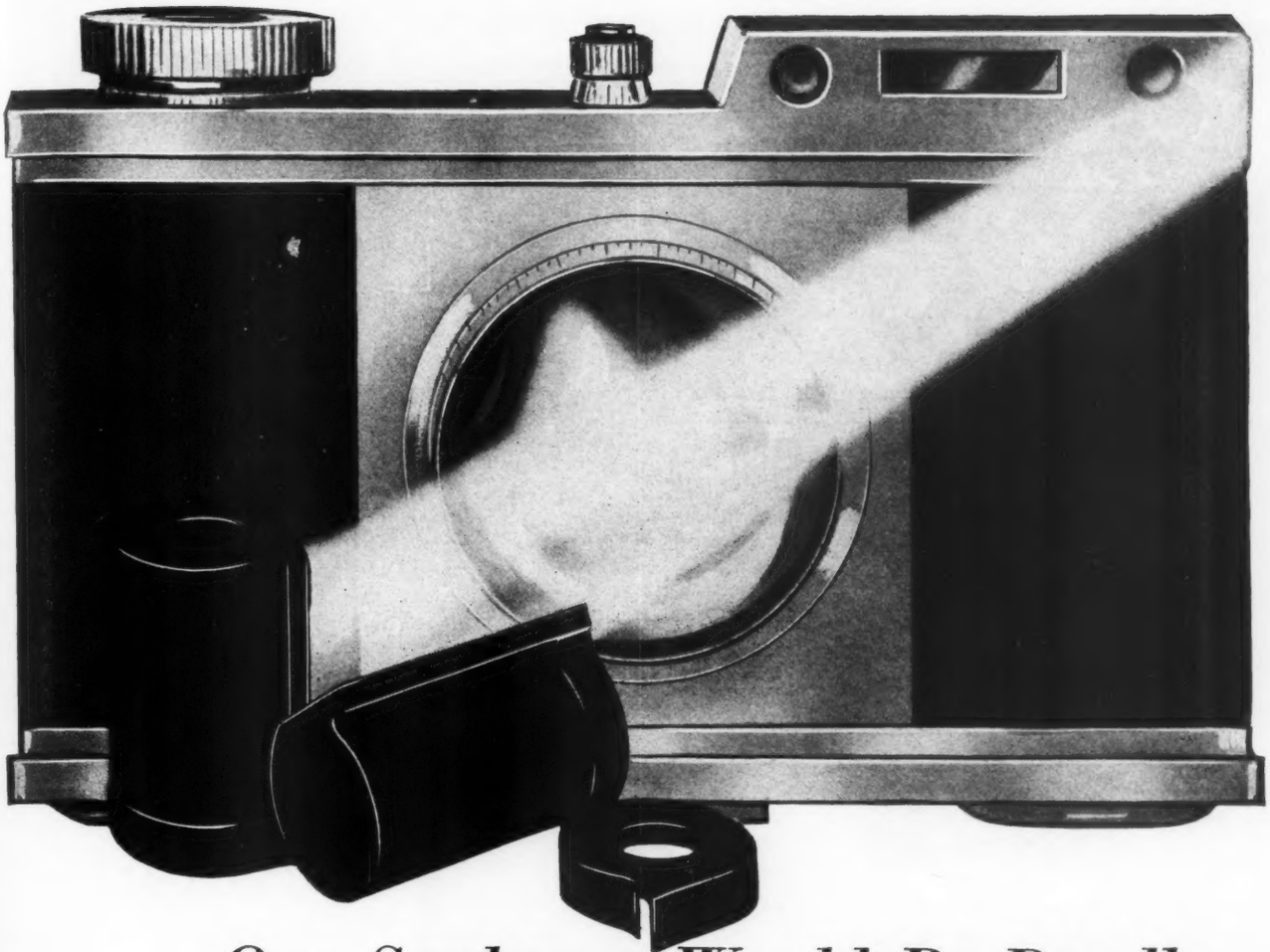
After seven years in the position of Office Manager of the Cincinnati branch office of The Holtzer-Cabot Electric Company, Mr. Button was transferred to that company's home office at Boston,

C. T. BUTTON

where he is now sales engineer in a supervisory capacity in connection with applications of special motors. Much of his time is devoted to the study of the various requirements and specifications of motors needed to suit a wide range of industrial uses.

**George W. von Hofe,** who supervised the design of the Pony Labelrite labeling machine described in the Modern Designs section of this issue, received his technical training at Stevens Institute, graduating in 1921 with an M.E. degree.

After several years as instructor of mechanics, Mr. von Hofe joined the New Jersey Machine Company in 1923, working successively as a draftsman, shop production manager, and designer on automatic container making machinery and labeling machines. In 1936, he was made vice-president in charge of production and design at the New Jersey Machine Company.



# *One Sunbeam Would Be Deadly*

**Sheathed in this holder of steel and brass, thousands of 35 millimeter films go forth, protected from sunlight and damage, to the growing army of miniature camera enthusiasts.**

**A leading film manufacturer turned to Scovill to produce a holder that would be**

***neat-looking absolutely light tight inexpensive***

**Though originally planned as a two-piece item, Scovill found that manufacturing could be simplified and costs reduced by making it in three pieces (two end caps and body). Impenetrable seal against light, and absolute uniformity, are guarded by constant inspection.**

**Steel in sheets, lithographed with the name of the film and its manufacturer, is cut and formed to the unusual body shape. End caps, for manufacturing economy, are of brass finished in black.**

**Only 1⅝ long, about 1″ in diameter, this container is nevertheless one which requires utmost economy combined with precision and quality. Production in large quantities by Scovill's complete facilities, with manufacturing costs cut by improvements worked out in the development stage, means noteworthy savings for the film manufacturer.**

**Why not call us in to see if we can serve *you* in the quantity manufacture of made-to-order metal parts and products. A letter to 35 Mill Street, Waterbury, Conn., or to any of the offices listed below, will bring you more information.**

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# AUTHORS AND CONTRIBUTORS

**J. R. Brossman,** author of the article "Organic Finishes," has been continuously associated with the General Electric Company since March 1917. He was graduated from Pennsylvania State College with a B.S. degree in Chemical Engineering, and later received a degree in Metallurgical Engineering from the same institution.

Following his graduation and before joining the General Electric Company Mr. Brossman worked a short while as

J. R. Brossman

a chemist in the laboratories of the Pennsylvania Railroad at Altoona, Pa. His first position with the General Electric was as a chemical and metallurgical engineer in the Pittsfield Works' laboratories. In 1927 he was transferred to the Philadelphia Works and placed in charge of materials and processes, two years later he was appointed chief of the Philadelphia Works' laboratories, and since 1933 has been in charge of all incoming laboratory materials.

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**Alvin G. Brooks,** who presents the article "Analysis of Variance," after graduating from Ripon College became associated with the Western Electric Company. He is chief of the Rating and Statistical Section in the organization of the Works Comptroller at the Hawthorne Works of the company at Chicago, Ill.

Alvin G. Brooks

Mr. Brooks is a member of the American Statistical Association and the Institute of Mathematical Statistics.

•

**C. M. Sayre** presents the case for the use of standard motors in his article "Standard Motors—Economies Obtained by Their Use" appearing in this issue.

After his studies in electrical engineering Mr. Sayre was employed for a short time by the Fisk Rubber Company, later he was employed by the Springfield Aircraft Corporation and the Split-Dorf Electric Company on production work. During the war he was with the United States Marines.

For the past seventeen years Mr. Sayre has been with the Westinghouse

C. M. Sayre

Electric & Mfg. Company serving in the capacity of supervisor of production in the automotive, radio, and small motor division; superintendent of the small motor division; and assistant sales manager of the small motor division which position he now holds.

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## A Tough Problem

NOTCH TOUGHNESS, one of the most lively discussed subjects at the annual meeting of the American Society for Testing Materials in Atlantic City last June, is arousing many differences of opinion. In our article on this subject in this number, (beginning on page 332), we have merely high-lighted the subject. Frankly, every metallurgist and engineer to whom we submitted the manuscript for comment and criticism, disagreed with some statement or other or suggested further clarification of certain phases of the subject. However, we secured agreement from at least one authoritative source on every statement in the article. And with the feeling that there was enough in the article for a starter, we left further discussion for future issues.

With the rapidly increasing importance of stress concentration, largely because of the higher working stresses necessitated to secure minimum weight, the question of notch toughness is of increasing importance. Of course the obvious answer is to design so that there will be no stress concentration. But this is not always possible. Thus there arises the problem of evaluating the notch toughness of the materials. How to evaluate this property correctly? This is the problem that now has focused upon it the attention of both engineers and metallurgists. We invite expressions of opinion.

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## A Story That Must Be Told

THERE ARE those who take the stand that industry in all its relations has been "Simon pure." And there are those who berate and damn industry for dastardly acts. Neither group is correct, as all clear-thinking men will agree. With reference to patent situations there have been abuses in the past. There are still some abuses. Perhaps they can be corrected or perhaps they have been reduced to the average fallibility of human nature. If the latter, nothing much can be done about it without doing more damage than good.

Whatever may be the situation, intelligent judgment cannot be passed upon the patented products situation unless there is a clear understanding of the activities behind the scenes in research and the development of new products. To the best of our knowledge it is a story that has never been told.

In a special supplement in October *Product Engineering* we will tell something of the story of research in America. Pictorial charts will give some of the statistics for a group of leading companies—the amount of money invested in buildings and equipment, the annual expenditures, and the number of scientists engaged. And a running story will give a resumé of research achievements, who accomplished them, how and why, and what it all means to the standards of American living.

# *Case Study of a* RAZOR CASE

A minimum of weight, a surface practically impervious to scratching or chipping, were the requirements laid down for this deluxe safety razor case.

To meet these requirements, Scovill produced for a leading razor manufacturer the case pictured above. It is fabricated from aluminum, finished in gold-colored Indurite* and fitted with a polished metal mirror. It will soon gleam on the counters of America's drug and department stores; and better still, gleam on the bathroom shelf after months of soap, water and abuse.

An electrically produced transparent oxide surface on the metal produces its hardness and resistance to wear. Impervious to moisture, heat-resistant, often more durable than plating, Indurited surfaces are available in natural aluminum, gold, and a wide range of other colors. The finish has the satiny feel of high-grade vanity cases and jewelry.

***Other Applications for "Indurite"*** Besides razor cases, many other aluminum products are improved through the use of this Indurited finish — products such as electric refrigerator fittings, range trim, timers, clock and instrument bezels, ash trays, vanity cases and lipstick containers, flashlights, gasoline hose nozzles and other products where permanent beauty of finish is required.

Whether or not Indurite would be valuable to your product, why not put up to us your metal-working problems? Our engineering facilities can tie in at the stage of a mere idea, a design, or a working model. Often we have helped customers make mechanical improvements and have saved in construction both by refinements in design and by facilities for mass production.

More information is yours for the asking, from 35 Mill Street, Waterbury, Connecticut, or any of the offices listed below.

*Indurite is the Scovill Manufacturing Company's trade name for alumilite finish.

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**Albert B. Willi** contributes his third article on the subject of bearings in this issue, it deals with "Life Expectancy of Bearings as Effected by Manufacturing Processes." Previous articles appeared in the January and February 1937 numbers of *P.E.* This is the first opportunity, however, that we have had to introduce properly Mr. Willi to our readers.

After some early experience in the engineering department of the Philadelphia & Reading Railway, Mr. Willi took a position with the Continental Motors Corporation as layout draftsman. Feeling the need of more knowledge of machine shop

A. B. WILLI

and foundry practice, he entered the employ of the Royersford Foundry and Machine Company, after which he returned to Continental Motors and later became executive engineer and assistant chief engineer of that company.

For the last few years Mr. Willi has been associated with the Federal-Mogul Corporation as their chief engineer. In this capacity much of his time is devoted to directing research work having for its purpose the improvement of bearing design and the better use of bearing materials. Mr. Willi is a member of the American Society of Mechanical Engineers and also of the Detroit Engineering Society.

**J. B. Kommers** presents and describes in his article "Design-Stress Diagrams for Alternating Plus Steady Loads" a method, which should be of much interest to designing engineers, for arriving at safe stress values for designing parts of machines and structures that are subjected to both alternating and steady loads.

For many years much of Professor Kommers' work has been teaching, research and technical writing. His greatest interest in research has been in the subject of fatigue of metals. In 1920-21 Professor Kommers spent a year and a half at the University of Illinois, as engineer of tests in connection with the Joint Investigation of the Fatigue of Metals of which Prof. H. F. Moore had general charge. Professor Kommers' research

*DeLonge Studio*

J. B. KOMMERS

work is also well known in England and Germany; one book of which he is co-author with Professor Moore, "The Fatigue of Metals," has been translated into Russian. Four articles by Professor Kommers have been published in *Engineering*, London. He is also co-author with Prof. P. H. Hyland of the text book "Machine Design" now in its second edition.

Professor Kommers has been Professor of Mechanics at the University of Wisconsin since 1927. He is a member of the American Society for Testing Materials, the Society for Promotion of Engineering Education, and also the American Association of University Professors.

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## *They Made It Possible*

The problem of "Public Relations" is in the limelight now. And one of the biggest stories that has never been told fully, and probably never can, is the story of "Research in America." What is research; where does it end and engineering development begin? How does industry cash in on its research results? Who discovered this and that? How about the claimed exploitation of patents or their suppression? Dozens of questions are involved. We wanted the answers.

And then we found many reasons why the stories have never been told. Companies were reluctant to give figures on expenditures for research and number of men employed. They didn't know exactly what was spent for research and what for engineering development; there was much overlapping, and they were afraid of giving false figures. But some of the companies got the spirit of the idea and went to a great deal of trouble to dig up figures. Admittedly all are not exact, but are as near as could be estimated.

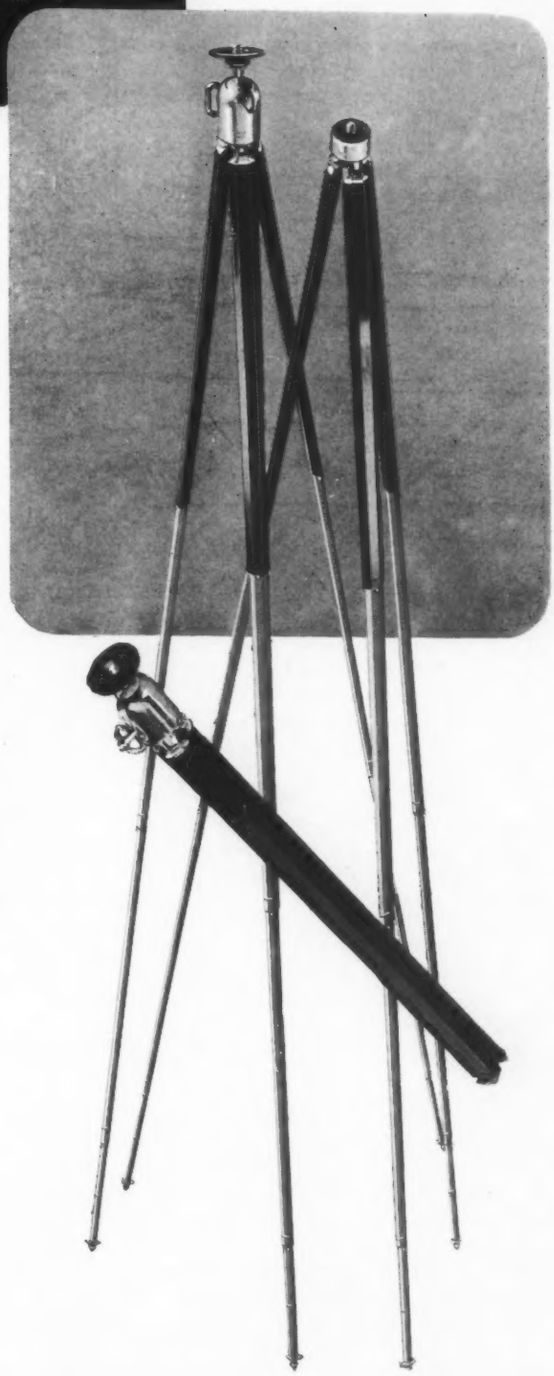
Then we talked to research executives and found them reluctant to take credit for anything except a few basic discoveries. "We were not the only ones who worked on this. Many steps were involved and others should also get some credit." The research men were too modest and had it not been for the wholehearted cooperation of others who knew the inside story, the articles could never have been written. For the story in this number, our thanks to Guy Bartlett of General Electric Company, Hendley N. Blackmon of Westinghouse and Everett W. Melson of Bausch & Lomb Optical Company for their unfailing cooperation.

## *How's Business and What's New?*

**November *P.E.*** will answer this question as it applies to the engineering designer. About 500 engineering executives have told us how many engineers, draftsmen and research workers are employed now, how many a year ago; what month this year they reached the low point in engineers employed, how many men added since, and whether they expect to add more soon; and what new products or models they are now developing or redesigning.

What's new will be told in a running account such as appeared in November 1936 *P.E.* based on the reports of several hundred companies on their new mechanical and electrical devices, their new metals, alloys, plastics and finishes. Applications of them to the design of modern machinery and equipment will be described and illustrated, so that the reader will have "more to judge by" when thinking of the possibility of applying the new things to the improvement of his design. And in addition, many ideas will be found in the illustrations and pithy descriptions of the modern designs shown.

# FLAT STEEL
## for STRAIGHT SHOOTING



Even the most expensive tripods have had the vibrating bugaboo when fully opened. But here is one that will hold the camera for as crisp a picture as anyone might desire. It's made by Scovill primarily from *flat steel stock.*

Twenty-six different parts are involved in its manufacture. The tripod legs themselves are in four sections, yet the *over-all* taper required for perfect telescoping is accurately maintained. 49″ long, open, and 16½″ long closed, its individual units are from 9½″ to 14″ inches long, to permit a compact piece for carrying.

Ingenious swivel and double locking arrangements on the versatile head of the tripod can be best appreciated, from a production standpoint, only upon close scrutiny. Original specifications for the job were laid down by the customer, a nationally known source of supply for photographic materials and cameras. Scovill engineers developed the specifications further and adapted them for economical production.

This job, developed by Scovill, working in close collaboration with the customer, is one of the many that come to Scovill as blueprints . . . as models . . . or as an idea. You present them. Scovill has the engineering staff and the equipment to produce them advantageously.

Today — sit down and write us about the production of any metal part or product with which you are associated. If we can help you, we will, because this is *our* business. The part need not be steel, for Scovill also works in brass, bronze, copper, nickel silver, aluminum and other metals. Address any of the offices below, or write direct to the Company at 35 Mill Street, Waterbury, Connecticut.

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ABOUT OUR

# AUTHORS AND CONTRIBUTORS

**Raymond F. Yates** is presented rather informally but judging from the number of books he has written and his many other activities, he has probably discovered that when ideas come popping even shirt sleeves are too constraining. While the article "Plating Aluminum" is the first from Mr. Yates to be presented in *Product Engineering*, his writings are manifold and well known.

Mr. Yates has been editor of *Everyday Engineering*, managing editor of

RAYMOND F. YATES

*Popular Science Monthly*, editor of *Popular Radio*, and editor of *Television*. Eighteen books from his pen have been published, they deal with radio, television, electronics and broadcasting; patents and inventions; models and toys. Besides all this, he has invented numerous devices.

Mr. Yates was a member of the Hoover Radio Conference. He is vice-president and general manager of Krome-Alume, Inc., manufacturers of stainless aluminum.

**Graham Lee Moses,** author of the article, "Magnet Coil Design," has been continuously associated with the Westinghouse Electric & Manufacturing Company since his graduation from the Bliss Electrical School in electrical engineering. After a graduate student

GRAHAM LEE MOSES

course in the Westinghouse company he was made renewal parts and maintenance engineer in the railway sales department, later becoming railway control engineer and then coil and insulation engineer, which position he now holds.

Mr. Moses has been active in the company's development of new equipment for the railway industry. He is particularly identified with developments such as inductive shunts and shunting equipment for speeding up street cars and trolley coaches, multi-notch vernier control for street cars, automatic control for trolley coaches and numerous applications of glass insulation. Mr. Moses has prepared numerous manuscripts on maintenance subjects and applications of glass insulation.

**Clinton W. Blount,** the author of this month's lead article, "Molded Plastics," received his preliminary education in Texas. He later attended the Marion Institute in Alabama where he was a part-time instructor in mathematics and tactical officer preparing for the United States Naval Academy. After graduating from the Naval Academy at Annapolis in 1922, he joined the Radio Corporation of America as a salesman and remained with that concern until March 1924. Since then he has been with the Bakelite Corporation, primarily associating with the sales department. After a year of preliminary training in the use and application of molding materials, Mr. Blount was assigned the position of district sales engineer in New York, and in 1932 was appointed assistant sales manager, his present position.

CLINTON W. BLOUNT

*Blank & Stoller*

## *Engineering In Washington*

MANY THINGS will be happening in the near future in Washington, D.C., that will greatly affect the profession of engineering. The hearings of the monopoly investigating committee are tentatively scheduled to begin in December. Engineers, research workers and industrial executives will be called to Washington to attend the hearings of this committee, one of the first activities of which will be an investigation of the patent situation. They hope to determine the manner in which patents tie in with monopolies. And in investigating this problem they will begin with getting the facts relating to the cross licensing of automobile patents and the factors involved.

Along this same line there will be numerous other activities in Washington for the purpose of procuring the maximum coordination in certain phases of industrial engineering activity. These will possibly include the problem of organizing for maximum coordination of research and engineering developments in industries such as aircraft, for example. There has been no official announcement of any such plans but one must conclude that such coordination would merely be another step in the plan of industrial mobilization for war emergencies.

Added to all this the next Congress will undoubtedly propose legislation relating directly or indirectly to patents or patent licensing.

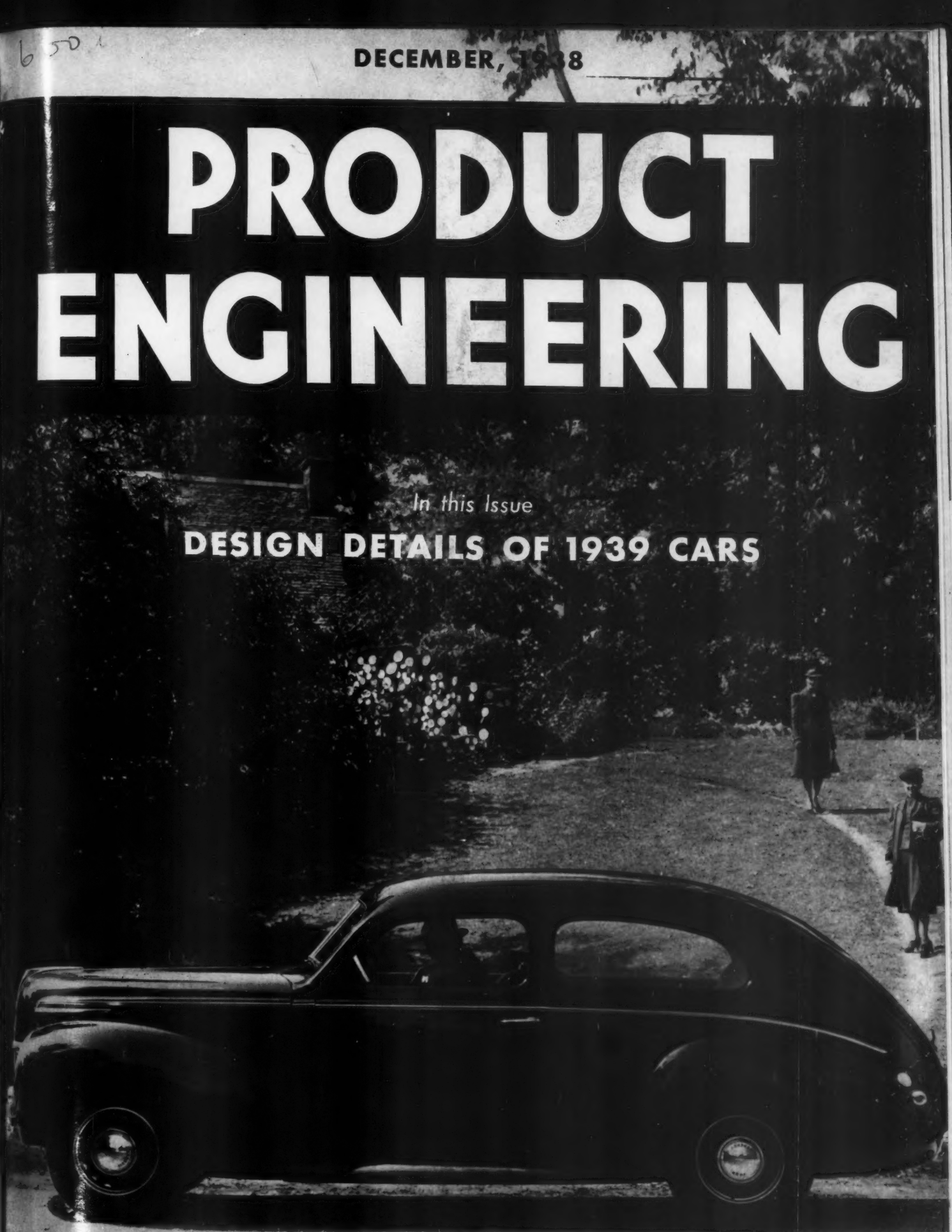
At this time it is too early to state definitely the full scope of Washington activities relating to engineering and research. However, through Paul Wooton, Washington representative of *Product Engineering*, and with the assistance of his able staff, we will keep our readers informed on these developments. Our presentations will in no wise bear a political flavor and will confine themselves to presenting the facts. These facts will be presented monthly on this page, under the title as above, "Engineering in Washington," and will be solely on matters concerning engineering.

DECEMBER, 1938

# PRODUCT ENGINEERING

*In this Issue*

## DESIGN DETAILS OF 1939 CARS



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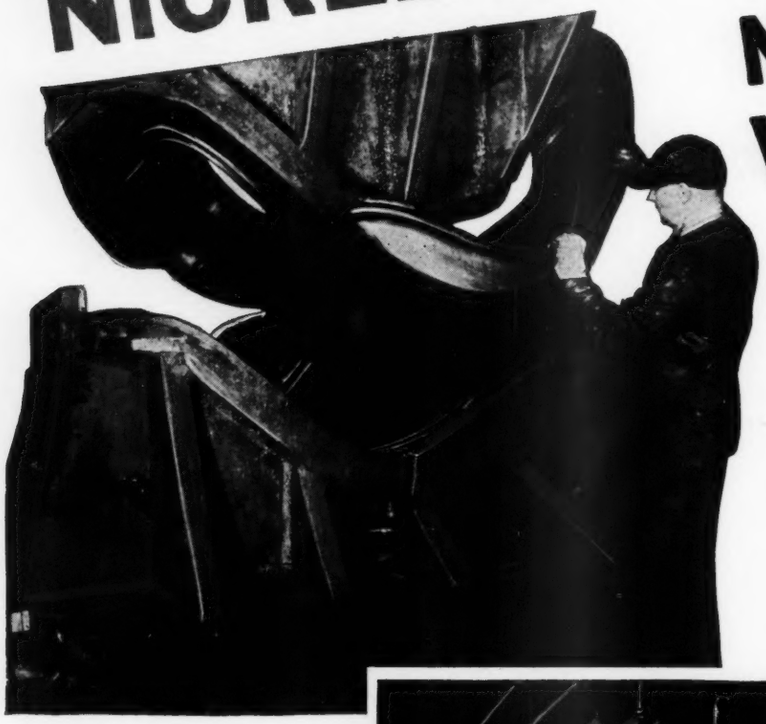
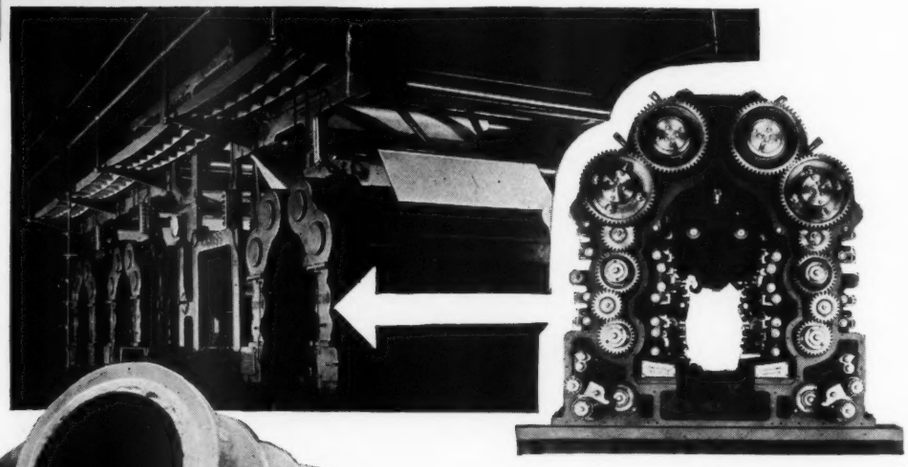
McGRAW-HILL PUBLISHING COMPANY, INC., NEW YORK, N.Y.

# NICKEL *turns the oldest metals to* NEW and WIDER USES



Among the metals whose commercial use dates back for centuries is cast iron . . . a material that has always been highly respected for its adaptability, machinability and low cost. Times have changed . . . so has cast iron — thanks to scientific foundry practice and the intelligent use of alloying elements — principally Nickel. Considerably stronger, harder and more wear-resistant than the unalloyed product, Nickel Cast Iron is economical for many modern applications. For example, the Nickel cast iron fender forming die pictured here is capable of stamping out more than 30,000 automobile fenders without redressing. This performance is 3 to 6 times greater than is possible with plain grey iron and results in fewer interruptions of the production schedule for regrinding operations as well as appreciable reductions in maintenance costs.



Here is a modern newspaper press manufactured by Goss of Chicago in which all the gears are made of Nickel Cast Iron. In selecting this material for this application, Goss engineers were able to take advantage of the initial economy of cast iron. In addition, they obtained gears capable of withstanding the stress and wear of high speed operation — thanks to Nickel.

## NICKEL CAST IRONS

Modern railroads cannot tolerate excessive locomotive failures. For instance, in cylinders, due to the trend towards greater tractive effort at high speeds, higher boiler pressures and superheated steam with its increased cylinder temperatures, strength, density and pressure tightness are the prime requisites. That is why railroads are turning more and more to Nickel Cast Iron for this purpose and various other applications demanding these all-important properties.

Our casting specialists will be glad to consult with you and suggest where the Nickel Cast Irons will effect economies in your plant or equipment.

**THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.**

# PRODUCT ENGINEERING

VOLUME 9 NUMBER 12

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**Cover Picture**—1939 Ford Mercury

### Coming Issue

The articles "Die-Cast or Stamped" by Herbert Chase which appeared in the August and October numbers of *P.E.* brought forth a flood of suggestions for similar articles on other types of construction. So we commissioned Mr. Chase to contribute a similar article on cold forged parts. This he did, working with the cooperation of the engineers of Lamson-Sessions, and the article will appear in January *P.E.*

Other feature articles in January include one on motor design by T. C. Lloyd of Robbins & Myers; the relation between proper fillet radius and metal hardness; bearing design; and resistance welding.

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# "TOO IMPORTANT *to be overlooked*"

**BUCYRUS-ERIE COMPANY**

GENERAL OFFICE
SOUTH MILWAUKEE, WIS.

August 19, 1938.

Mr. W. E. Kennedy, Manager,
Product Engineering,
330 West 42nd Street,
New York, N. Y.

Dear Mr. Kennedy:

Referring to your recent question, I am of the opinion that the advertising sections of all the professional engineering magazines are too important to be overlooked. Through the advertisements we can learn about new developments by competitors and the advantages which they think most important to point out to the trade. We can also keep up to date on parts, be it new metal alloys or designs which we must buy and fit into our products.

We use the products of many of the advertisers in the technical magazines. A good "ad" often says more than a long written article.

Yours very truly,
BUCYRUS-ERIE COMPANY

Werner Lehman

Chief Engineer -
Division A

WL:CR

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The above photograph shows the six different sizes of Boston Gear standard Ratiomotors — 54 various output speeds in 8 power sizes ranging from 1/20 to 3 horsepower — always in stock ready for your immediate use. Our general catalog #52 contains complete specifications and list prices of all these units, so if you order any Ratiomotor listed in this publication you know you will save time — because it will be in stock ready to be on its way to you.

Send for your free copy of our General Catalog #52 containing specifications and list prices of all Boston Gear Ratiomotors carried in stock.

*Trade Mark Reg. U.S. Pat. Off.

**BOSTON GEAR WORKS, INC.**
**NORTH QUINCY, MASS.**

BOSTON GEAR WORKS, INC.
NORTH QUINCY, MASSACHUSETTS

Please send me _____ copies of your General Catalog #52.

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# Look for the answer to metal-working problems in *Alcoa Aluminum Alloys*

Rotors being "assembled" by die-casting Alcoa Aluminum Alloys.

BASED ON the fact that electrical conductivity of Aluminum varies according to the alloy, motor manufacturers obtain different starting characteristics in squirrel-cage motors with apparently identical rotors. The production of these rotors by the die-casting method is pictured here. Molds and casting procedure remain the same; simply the Alcoa Aluminum Alloys are changed.

You can make the alloys of Alcoa Aluminum work for you. Available in every commercial form, they provide a wide range of possibilities, and can be fabricated by standard metal-working methods.

Hydraulic extrusions offer unique design advantages. Alclad* products have extremely high resistance to corrosion. Alumilite* finished products provide colors and good resistance to abrasion. Pressings open up new economies in fabrication. Alcoa screw machine stock permits a substantial increase in cutting speeds. And Aluminum has many other desirable properties.

For data on all the properties and commercial forms of Aluminum, write for the booklet, "Alcoa Aluminum and Its Alloys." There is a *best* alloy for each purpose. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pennsylvania.

*Patented

MADE *Economically* OF ALLOYS OF ALCOA ALUMINUM

ALCOA · ALUMINUM

# There are many good reasons for changing to *Aluminum Die Castings*

Showing fineness of finish and detail obtained with Alcoa Aluminum Die Castings.

DIMENSIONS of Alcoa Aluminum die castings are stable; there's no tendency for the metal to "grow," even when subjected to high temperatures. Witness the perfect performance of Aluminum equipment in the hot, moist atmospheres of processing plants. And the continued, smooth operation of closely-fitted parts exposed to the heat and high humidity of the tropics. You can depend upon Alcoa Aluminum die castings to retain their original shape and size.

The superior heat conductivity of Aluminum is a valuable asset where heat distribution is a problem. Aluminum can be given a wide variety of attractive surface finishes and, even when working at temperatures of several hundred degrees, it retains its fine appearance.

With Aluminum die castings, you get the combined weight savings resulting from the natural lightness of Aluminum and the thinner sections possible in the die-casting method.

Aluminum, of course, is resistant to corrosion. All of the advantages of die casting are retained with Aluminum; parts can be quite intricate, surfaces fine and dimensions accurate, thereby eliminating many expensive, tedious assembly and machining operations. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pa.

MADE *Economically* OF ALLOYS OF ALCOA ALUMINUM

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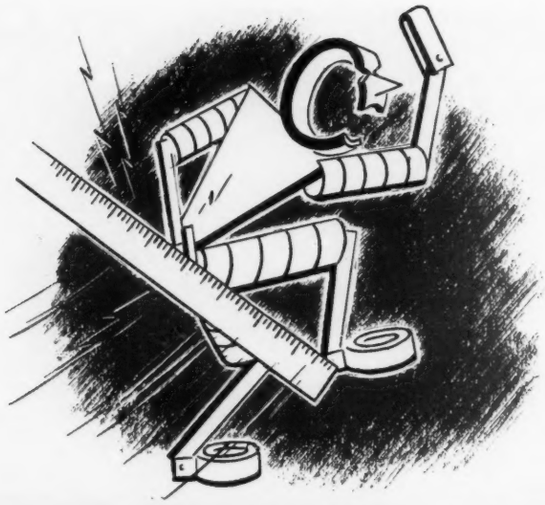
ALCOA ALUMINUM



# THE ROD ISN'T SPARED

## *Scientific "Bringing-Up" of Truflex Thermostatic Bimetal Insures Unspoiled Performance*

***In Fabricated Parts or Strip, Sheets***

Truflex Thermostatic Bimetals are furnished in strips, sheets, coils, or special parts manufactured to your specifications. Types are available to meet your requirements for temperature range, corrosion or electrical resistance, size limitation and cost.

Truflex

Thermostatic Bimetal

**GENERAL PLATE CO.**

*Division of Metals and Controls Corporation*
*34 Forest Street, Attleboro, Massachusetts*

There's an old saying "Spare the rod and you spoil the child." Consequently Truflex Thermostatic Bimetal is made to the highest standards of precision—tested, and checked again and again, heat treated and rolled by the most modern manufacturing processes. And as a result, Truflex is manufactured to the closest tolerances; is consistently uniform; meets your requirements exactly; and saves you the trouble and cost of expensive assembly adjustments.

Specify Truflex Thermostatic Bimetal for your built-in temperature control. A complete line is available. Moreover, our engineering staff is always ready to help on special problems. Let us quote on your requirements.

### General Plate Laminated Silver Contacts

You can cut costs with General Plate Laminated Silver Contacts. A sheet of solid silver permanently fused to an alloy base does away with the extra cost of unused silver. Moreover, General Plate Laminated Contacts in assembly are stronger, wear longer, and have greater heat dissipation than solid silver contacts in rivet form. General Plate Laminated Silver Contacts come in whole covered strips—striped—buttons—or special designed. Where contacts are mounted to thermostatic bimetal elements, General Plate can fabricate and furnish these complete. Write.

*Metals and Controls Corporation Divisions and Subsidiaries manufacture the following products: Spencer Thermostatic Controls, Klixon Disc Thermostats, laminated and solid precious metals electrical contacts, solid and rolled plated precious metals in all forms, Truflex Thermostatic Bimetals.*

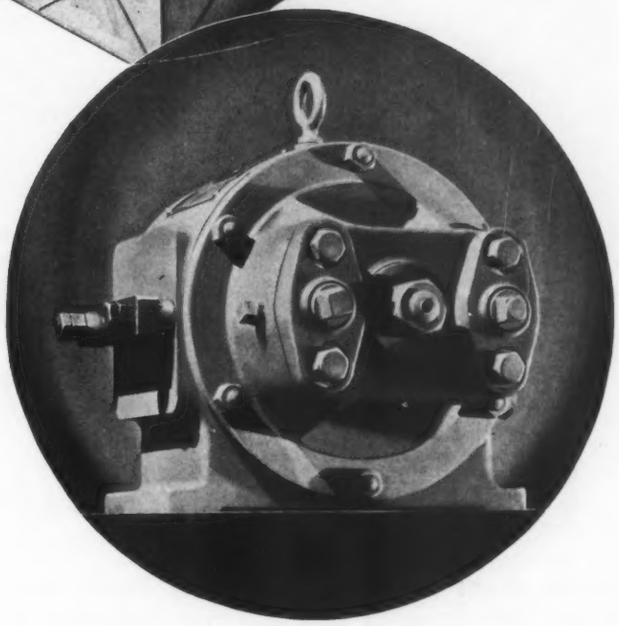
# HELE-SHAW FLUID POWER

## As *Convenient* to attach as a label to a box

Hele-Shaw Fluid Power is oil under pressure—used, like electric power, for driving machinery. The Hele-Shaw Pump generating the fluid power can be conveniently attached to almost any available place on (or off) the machine it drives. This is a big advantage and one easily explained by the fact that Fluid Power is carried through *pipes* from the pump to the point of application. There are no gears, belts or chains to line up. There are no obstructions Fluid Power can't pass.

Ease of attachment is only one reason why so many machine designers, builders and buyers are specifying Hele-Shaw Fluid Power. But there are other equally important advantages. Hele-Shaw Fluid Power increases production by instant and automatic adjustment to operating conditions, it is easy to control instantly and precisely.

Write in for complete details. **Ask us** to show you how Hele-Shaw Fluid Power can be applied to advantage in the machinery you design, build or buy. Specify Hele-Shaw.



**A-E-CO HELE-SHAW *Fluid* POWER**

**A-E-CO Hele-Shaw FLUID POWER**

OTHER A-E-CO PRODUCTS: Lo-Hed Hoists, Taylor Stoker Units, Marine Deck Auxiliaries.

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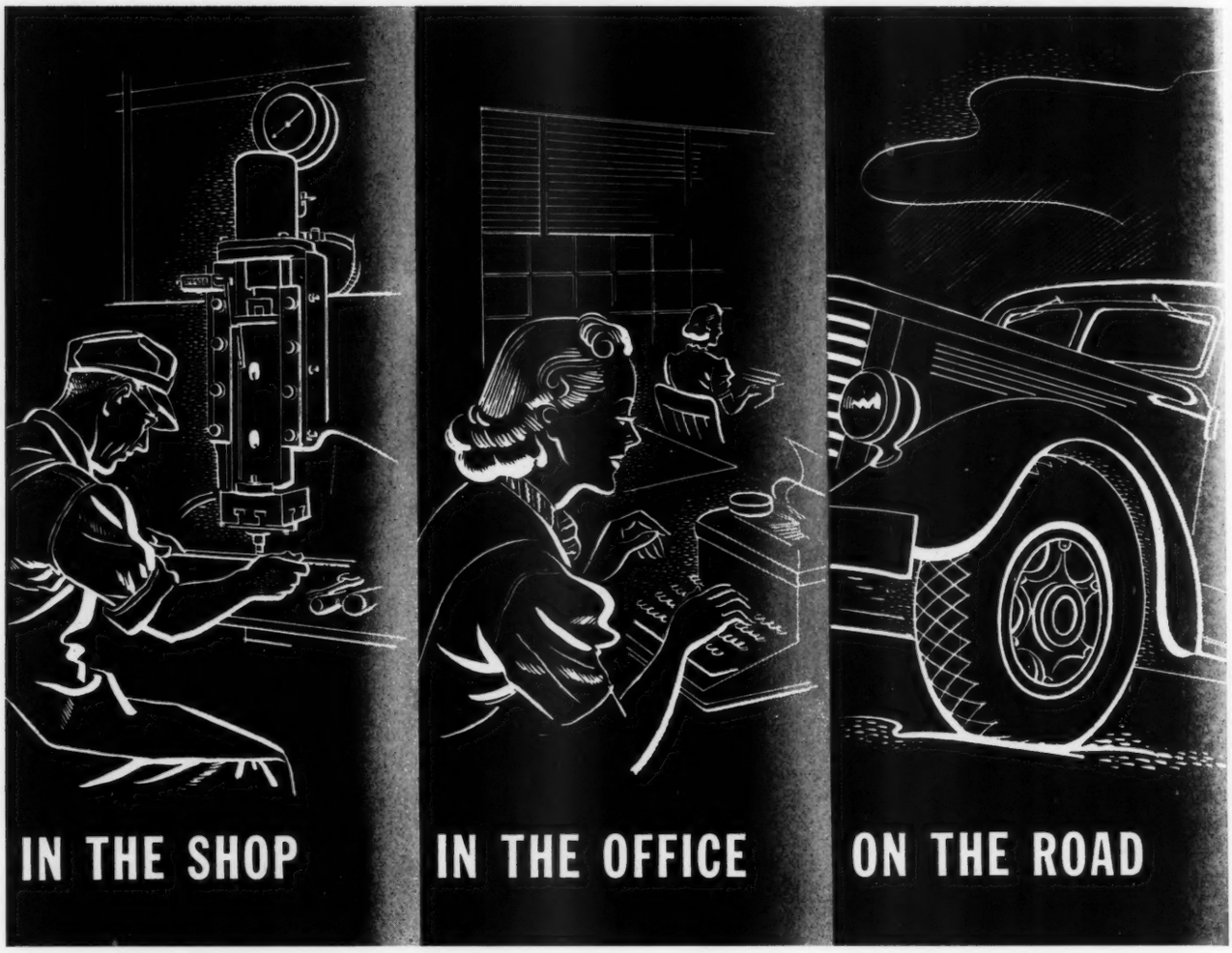

# *Machines can profit by built-in Veeder-Root counters*

**Management wants machines that count—machines that tell what they do—that give performance figures that form the basis of cost control, maintenance allowances, mileage costs, economy programs and efficient manufacturing. That is why typewriters, billing machines, presses, looms, fillers, cutters, trucks, and hundreds of others are equipped with Veeder-Root Counters.**

**Machines servicing practically all branches of industry use many types of Veeder-Root devices for counting, measuring, recording, or computing. Some of these applications are simple economical jobs. Others are special devices designed and installed through the cooperation of manufacturers and Veeder-Root's engineering staff. Almost all have resulted in a more practical, more salable product.**

**Can your product profit by a built-in Veeder-Root Counting device? Send for our free booklet "Counting Devices" now.**

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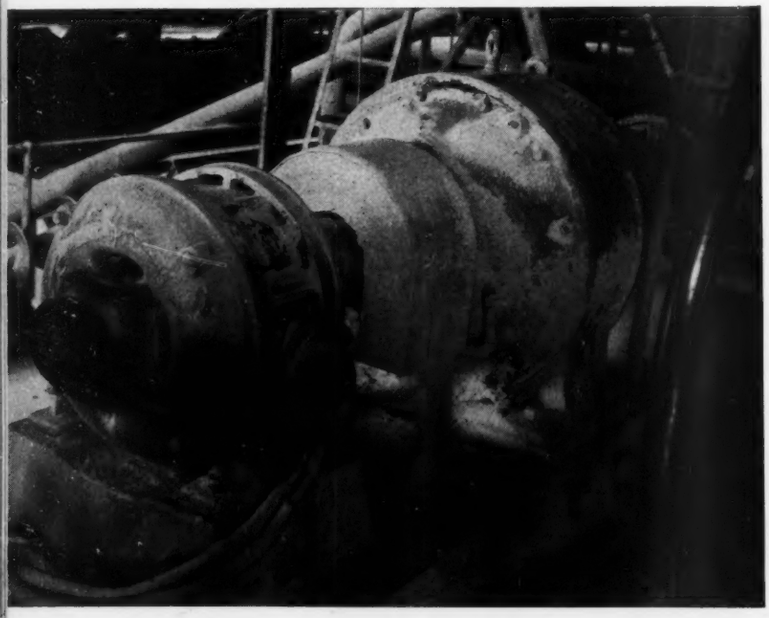
## Allis-Chalmers "Lo-Maintenance" Motors Save On Service Costs . . . This Means That Machines Equipped With Them Make Satisfied Customers For You and Increase Your Sales and Profits . . . .



No heavy service cost with this Allis-Chalmers "Lo-Maintenance" Motor that has swallowed abrasive dust every day for years.

Power the machines you design and build with Allis-Chalmers "Lo-Maintenance" Motors. Your customers know that the difference between red and black on the balance sheet is often determined by the amount spent for motor maintenance. They appreciate machines equipped with motors that save on service costs. They know that this saving means money to them . . . and this makes your machines easier to sell when they are equipped with Allis-Chalmers "Lo-Maintenance" Motors.

In plants all over the world, Allis-Chalmers "Lo-Maintenance" Motors are turning in records for trouble-free operation. That's the kind of motors your customers want and need. The way to sell those customers and increase your profits is to power your machines with "Lo-Maintenance" motors . . . this means more and easier sales and greater profits for you.

**You Get More Sales and Make Bigger Profits.**

Informed engineers and production men have found Allis-Chalmers "Lo-Maintenance" Motors the sturdiest on the market today. They recommend them for their ability to keep up production without costly shutdowns that cut so deeply into profit columns.

Call the nearest Allis-Chalmers motor representative. Have him show you how these motors save in service costs . . . how you can increase sales and profits by equipping your machines with Allis-Chalmers "Lo-Maintenance" Motors.

MOTORS FOR ALL APPLICATIONS
FROM ½ HORSEPOWER AND UP

ELECTRICAL DIVISION
ALLIS-CHALMERS
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# STANDARD

## A DIFFICULT JOB
## but not for STANDARD

Jobs like this tell their own story . . . the story of a complete organization, fully staffed with metallurgists and engineers to study users' problems; fully equipped for the manufacture of the most varied products, and fully manned with the trained personnel necessary to handle the most exacting kind of work.

We solicit your inquiries regarding any type of steel castings or forgings.

**STANDARD STEEL WORKS COMPANY**

Subsidiary of the Baldwin Locomotive Works

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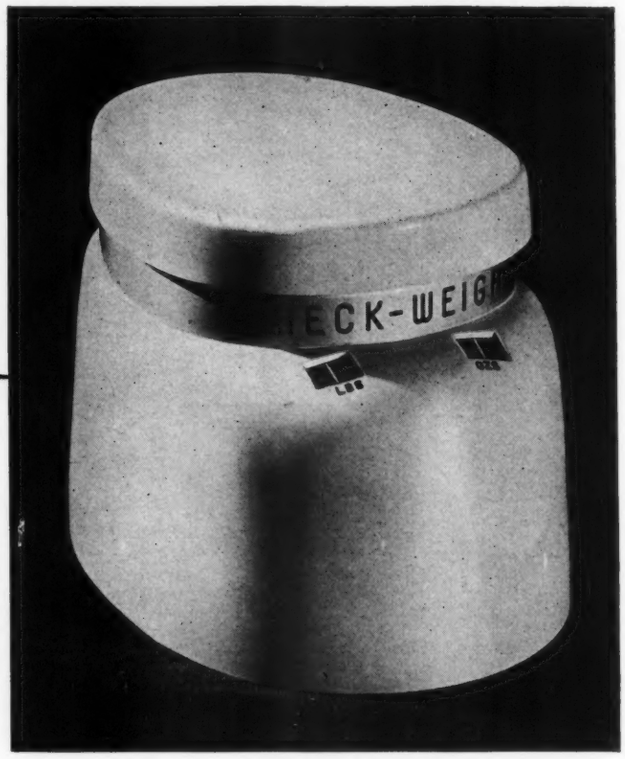
# CASTINGS & FORGINGS

HARRIS

# FUNDAMENTALS OF SUCCESSFUL MOLDED PLASTIC DESIGN

**NO. 6** ***Dimensional Changes in Molded Plastic Parts Should Be Discussed with Molder or Material Supplier—No. 6 of a Series Dealing with Principles of Correct Design for Molded Beetle* Parts.***




THE shrinkage factor of urea-formaldehyde molded parts is a point which should be discussed by the designer with the molder or raw material supplier.

Urea parts upon removal from the die will be from .007" to .009" per inch smaller than the original mold dimensions.

Further small dimensional changes will occur upon aging, and depending upon the humidity to which the parts are exposed. Under extremely humid conditions urea parts will expand slightly; in contact with very dry atmospheric conditions they will contract.

Allowances for dimensional changes in low and high humidities should be made when the material is in contact with rigid or semi-rigid parts. Fig. 1. If a metal back is placed in a radio or clock, allowance should be made for the contraction and expansion of the housing. Parts molded with metal inserts which are later bolted to a stationary frame should have some freedom. A rubber gasket may be used, or screw slots permitting some motion can be employed.

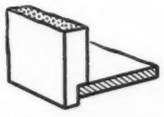
If two parts of different size or shape or different plastics are used on one job, allowances should be made for the shrinking factor of each.

In effect dimensional variations of the molded parts may be the result of many different factors, and we strongly advise that this matter be thoroughly discussed by the designer with his molder or raw material supplier.

**WHERE ALLOWANCE SHOULD BE MADE FOR SHRINKAGE**

FIG. 1

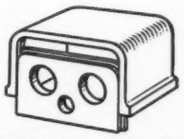
Metal frame or brace



Joints of metal and plastic

FIG. 2

Dimensional changes of parts joined by metal screw inserts must also be determined.



Dimensional changes should be calculated for demountable pieces to insure ample tolerances.

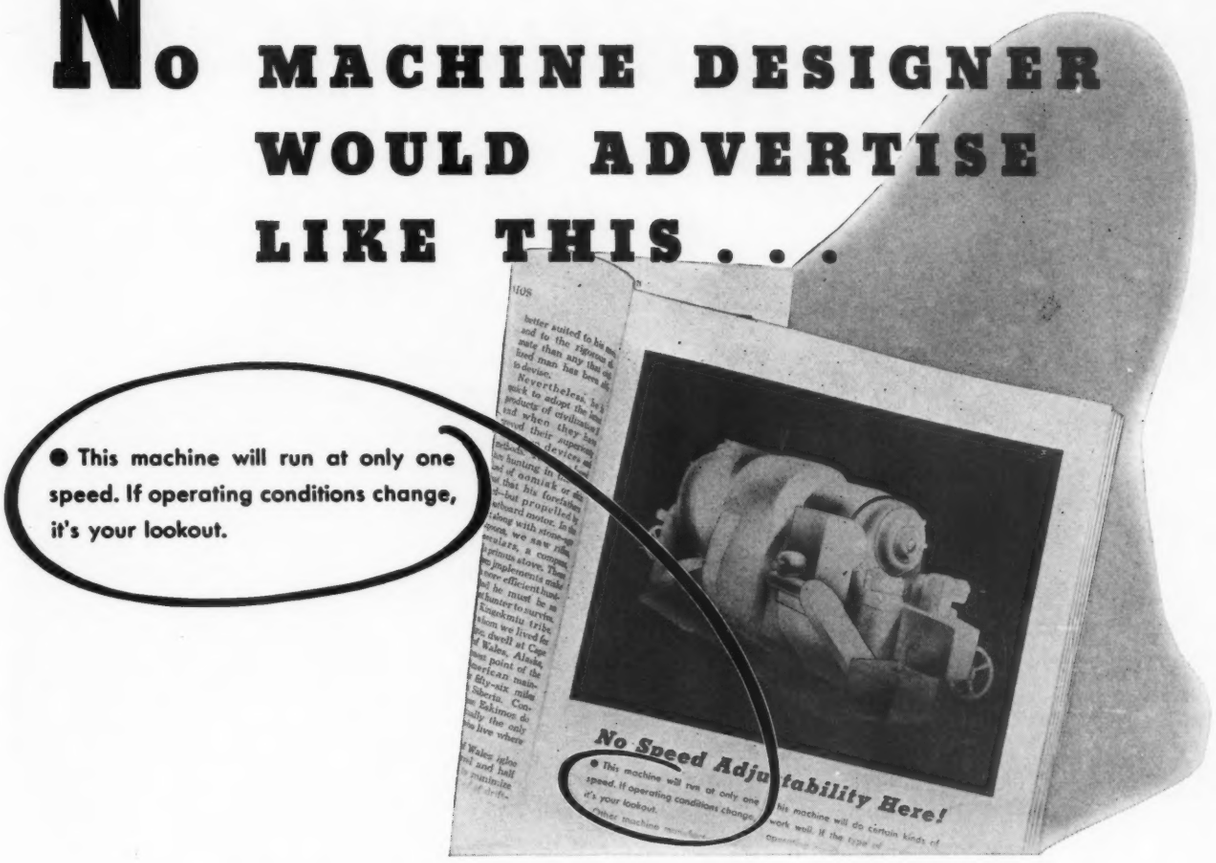
Beetle

IT'S ALL COLOR AND IN ALL COLORS

BEETLE PRODUCTS DIVISION OF AMERICAN CYANAMID COMPANY
32 ROCKEFELLER PLAZA • NEW YORK, N. Y.

*Trade-Mark of American Cyanamid Company applied to urea products manufactured by it.

# No Machine Designer Would Advertise Like This . . .


● This machine will run at only one speed. If operating conditions change, it's your lookout.
No Speed Adjustability Here!
● This machine will run at only one speed. If operating conditions change, it's your lookout.

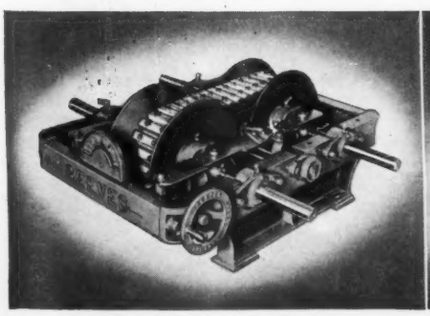
● Of course the machine designer and builder wouldn't say *that*. He knows, better than anybody, that it is impossible for him to decide the one best speed for *all* classes of work, for *all* conditions, for *all* grades of materials, and for *all* degrees of skill on the part of operators. And he knows, too, that making a statement of this kind would seriously interfere with sales.

Yet, *by implication*, he does say the same thing when he fails to provide the *positive and accurate variable speed control* which one of the three REEVES basic speed control units would give to the operator.

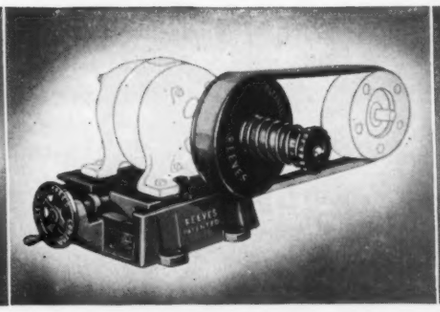
Manufacturers of nearly 1400 different machines have definitely overcome this handicap to sales and customer good will by including REEVES Speed Control as standard equipment. May we explain how variable speed may be *accurately* applied to your machines? Write us. No obligation.

REEVES PULLEY CO., DEPT. K-128, COLUMBUS, INDIANA

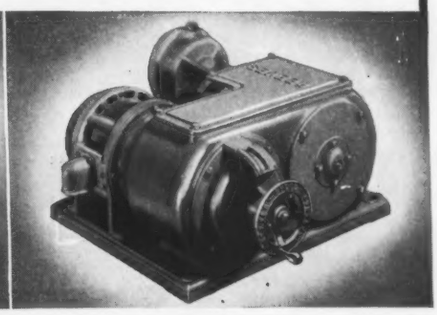
## REEVES SPEED CONTROL



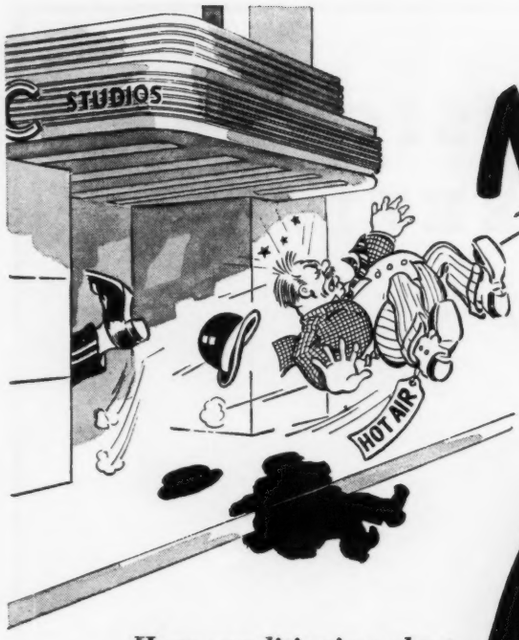
**VARIABLE SPEED TRANSMISSION.** Provides infinite speed adjustability over wide range. Accurate and positive at all speeds. Modern, compact open and enclosed designs, vertical and horizontal. Fifteen sizes—fractional to 100 h.p. Speed variations from 2:1 to 16:1 inclusive.



**VARI-SPEED MOTOR PULLEY.** Simplified development of Transmission. Mounts on standard shaft of any constant speed motor. Forms direct drive to machine. Sliding motor base is moved forward or back for speed changes. Seven sizes—fractional to 7½ h.p.; 3:1 range of variation.



**VARI-SPEED MOTODRIVE.** Combines in one compact, self-contained enclosure, constant speed motor, REEVES speed varying mechanism and reduction gears (where required). Available in space-saving horizontal and vertical types—¼ to 10 h.p. Speed variations 2:1 to 6:1 inclusive.




# N.B.C. puts BAN on HOT AIR

***Huge conditioning plant removing 10,800,000 B.T.U.'s an hour depends for its efficiency on Monel spray nozzles.***

*One of 1300 Monel nozzles used in Radio City's Carrier air conditioning system. These Monel nozzles have been in use 3 years. Bronze nozzles used in a former system failed in 3 months.*

If you want to keep cool visit Radio City. On a really hot day, enough heat is removed every hour to supply 250 average sized homes for *a whole winter*. Essential to the satisfactory operation of the huge air conditioning system are 1300 Monel spray nozzles like the one shown above.

Shooting from the Monel nozzles at a pressure of 25 lbs., a fine spray of water washes and cools the air. Operating for 20 hours a day, the nozzles must maintain an orifice size of $\frac{3}{16}$". Does Monel meet these exacting demands? Ask Radio City's Chief Engineer Robert Close, and here's what he'll tell you:

"When Carrier Engineering Co. installed this system* three years ago, I specified Monel nozzles because I knew what they'd do. Bronze nozzles used in the plant at our old building only lasted three months. Yet these Monel nozzles made by Buffalo Forge Co. are still good after *three years* . . . orifices still $\frac{3}{16}$". Not a sign of corrosion or erosion after 22,000 hours."

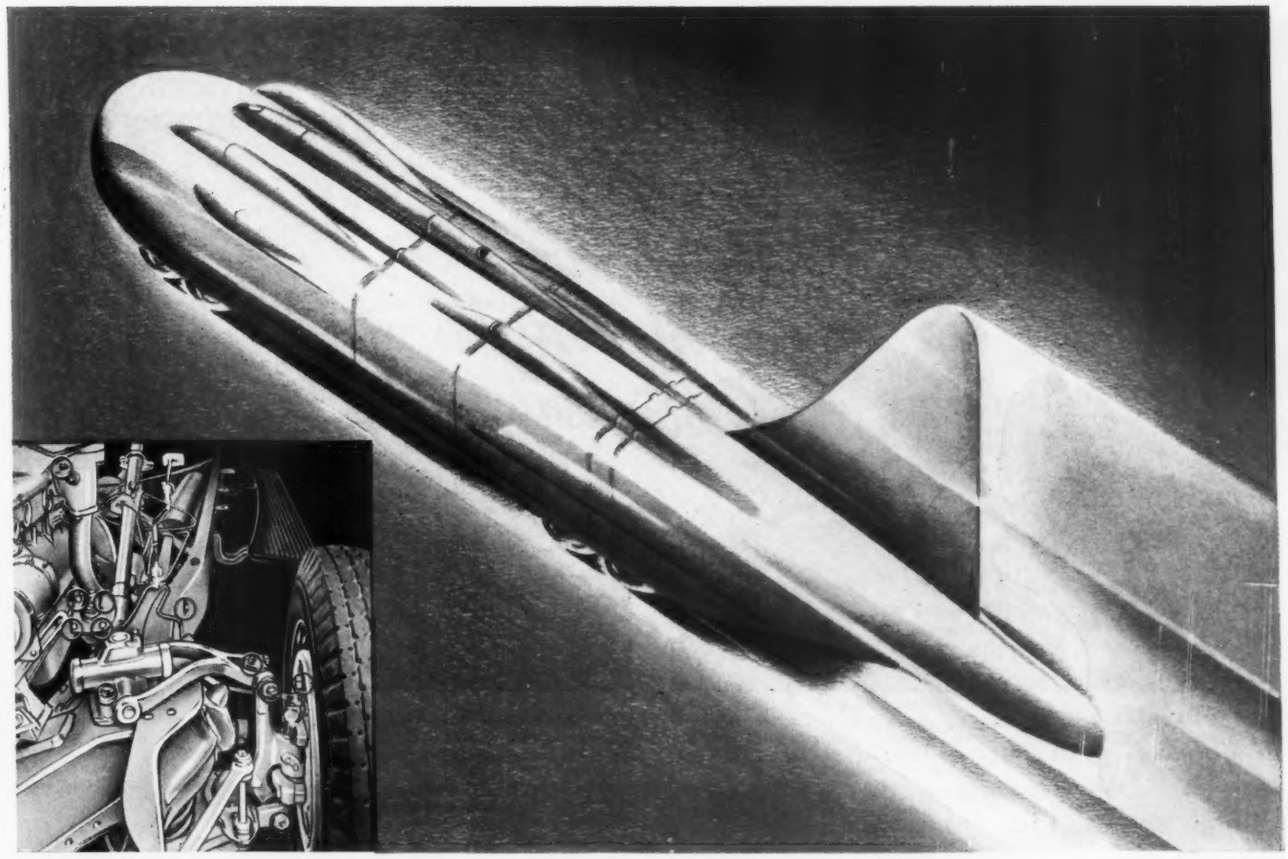
For parts of equipment subjected to extreme corrosion and wear specify Monel. This durable metal is tougher and stronger than steel. In addition, Monel is completely and permanently immune to rust, and resists corrosion by most commercial acids and alkalies. Write for further information on this long-lived metal. Address:

**THE INTERNATIONAL NICKEL COMPANY, INC.**
**67 Wall Street, New York, N. Y.**

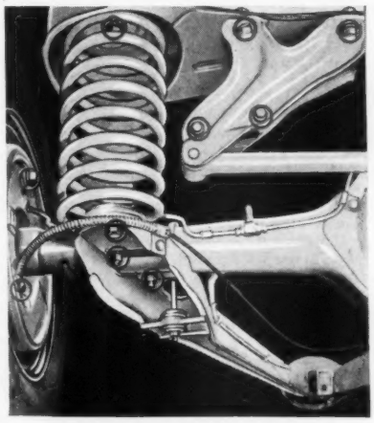
*Clyde R. Place, Consulting Engineer

INCO MONEL **MONEL**

"Monel" is a registered trade-mark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper.



Wherever failure *must* be prevented . . . as in steering assemblies . . . automotive engineers specify Helical Spring Washers.

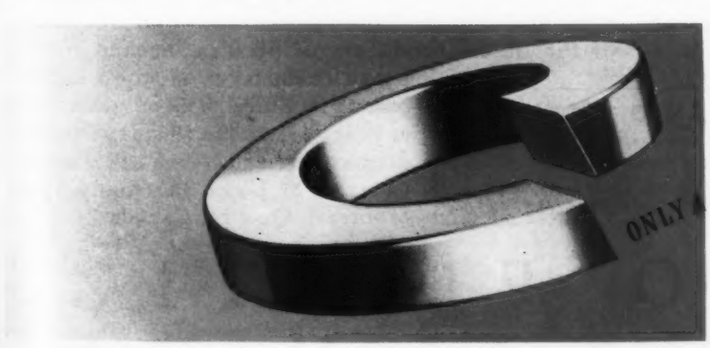


In rear spring assemblies and other parts of the chassis, *Live Action* of Helical Spring Washers backs up the safety theory of the drawing board with safety *practice* on the road.

# *WHERE Life's AT STAKE . . .*

## Industry uses Spring Washers to keep bolted parts tight

When taking a chance means risking life . . . the long range, *Live Action* of Helical Spring Washers is the *one* positive safeguard. The reason is definite. Bolts *do not* loosen *initially* because of backward turning of the nut . . . but because of wear, scale, rust, breakdown of paint and bolt stretching. A Helical Spring Washer exerts *maintained pressure* on thread surfaces, compensating automatically for initial looseness.




**SPRING WASHER INDUSTRY**

616 Wrigley Bldg. • Chicago, Illinois

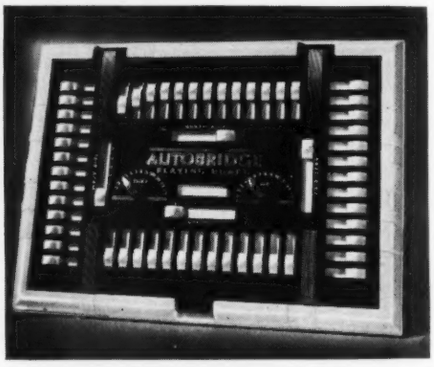
# *Two Wins.. One Place.. Two Shows.. for Monsanto Customers*

**FIRST AWARD—Industrial Group:** Pneumatic Tube Carrier, of transparent Monsanto Cellulose Acetate, for high-speed transmission of letters and papers, fabricated and sold by the Lamson Company, Syracuse, New York.

**FIRST AWARD—Novelty and Style Group:** Transparent Oil Cans of transparent Monsanto Cellulose Acetate Molding Powder. Molded by Universal Plastics Corporation, New Brunswick, New Jersey.

**HONORABLE MENTION—Decorative Group:** Cabinet of Monsanto Cast Phenolic Resin fabricated by Ortho Plastics Novelties, Inc., New York; grille and controls of Monsanto Cellulose Acetate Molding Powder molded by Foster Grant, Leominster, Mass. For Emerson Radio and Phonograph Company, N.Y.

**THIRD AWARD—Novelty and Style Group:** Sports Goggles of Monsanto Cellulose Nitrate. Fabricated and sold by Optical Products Corporation, New York.



**HONORABLE MENTION—Novelty Group:** Molded Autobridge Board including slide-knobs of Monsanto Cellulose Acetate Molding Powder. Molded by General Electric Company, Pittsfield, Mass. for Autobridge Inc., New York.

To any manufacturer considering the introduction or widened use of plastics in his product, there is significance in the results, just announced, of the 1938 Modern Plastics competition—premier annual event of the plastics fabrication industry.

Among other winners of Modern Plastics awards are these widely dissimilar products: a pneumatic tube carrier for letters and papers, transparent oil cans, a pair of sports goggles, a radio, and a contract bridge instruction and game device. Yet all five of these successful entries have one thing in common... *each is made, wholly or in part, of Monsanto Plastics!*

Such an array of winning products shows the versatility of Monsanto Plastics in the hands of skilled, imaginative craftsmen... indicates the likelihood that one or more of these plastics will be readily adaptable for increased sales-power in *your* product, with possible reductions in manufacturing costs.

Your letter addressed to Monsanto Chemical Company, Plastics Division, Indian Orchard, Massachusetts, will command the pioneering experience of one of the oldest producers of plastics, backed by the broad chemical production and research facilities of Monsanto. Also at your service are Plastics Division district offices in New York, Detroit, Chicago, St. Louis, Los Angeles and Montreal, Quebec, Canada.

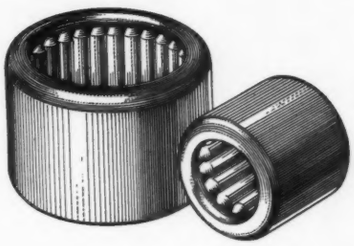
**MONSANTO PLASTICS**
Cellulose Acetate • Cellulose Nitrate
Cast Phenolic Resins
Sheets • rods • tubes • moldings • castings
Transparent Vue-Pak for packages and displays

# MONSANTO PLASTICS

PRODUCTS OF MONSANTO CHEMICAL COMPANY

# TORRINGTON NEEDLE BEARING

## DESIGN AND SERVICE FEATURES



## HIGH RADIAL CAPACITY FOR SEVERE SERVICE

***Small Sizes Take Heavy Loads***

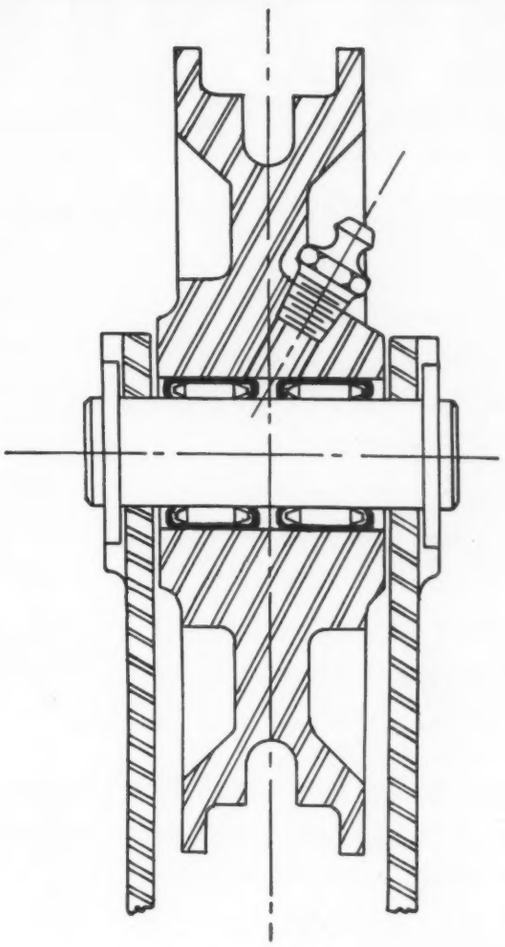
HIGH RADIAL LOAD CAPACITY of the Torrington Needle Bearing makes it ideal for use in applications where loads are heavy. In extremely severe applications, such as the chain hoist lower sheave illustrated, extra capacity bearings with a specially hardened shaft are used to increase still further the normally high capacity of the Needle Bearing. The many linear inches of contact provided by the bearing's full complement of small-diameter needles permit the use of relatively small bearings.

The turned-in lips of the hardened retaining shell hold a large supply of lubricant, and reduce the frequency with which service attention is needed. Grease fittings may be used to simplify periodic renewal of the lubricant.

**Low Unit Cost**

The Needle Bearing, offering the advantages of complete anti-friction construction, is comparable in overall cost with the use of simple bushings. The bearing itself is remarkably low in unit cost, and can be assembled in place quickly and inexpensively. The shape of the bearing — small radially and long axially — greatly simplifies the type of housing construction needed; a bore of the right diameter serves to mount the bearing. The bearing's unit construction, with its needles held by the hardened retaining shell, makes it very easy to assemble in the housing.

In considering the use of Needle Bearings, manufacturers are invited to avail themselves of the experience of the Torrington Engineering Department in laying out bearing applications. Further information is contained in the Torrington Needle Bearing Catalog, available on request. Write for Catalog No. 8.



*TYPICAL ILLUSTRATION OF TORRINGTON NEEDLE BEARINGS OF EXTRA CAPACITY IN SEVERE CHAIN HOIST SERVICE.*

*The Torrington Company*
ESTABLISHED 1866
*Torrington, Conn., U.S.A.*
*Makers of Ball and Needle Bearings*
Branch Offices in all Principal Cities

**TORRINGTON**
**NEEDLE BEARING**

# TRANSUE

# TRANSUE STAMPINGS

## *Three words that Fit Together!*

Whenever and wherever engineers discuss the development of new products or new parts—in which weight, strength, and appearance must be considered—**TRANSUE** is bound to be recommended as the logical source for valuable assistance in the **DESIGN** of unusual **STAMPINGS** that will do the job.

Any engineer or executive can freely write to Transue on any problem that does or might involve pressed steel—**WITHOUT INCURRING THE SLIGHTEST OBLIGATION.**

## TRANSUE & WILLIAMS

ALLIANCE, OHIO

DESIGNERS AND MAKERS OF DEEP DRAWN STAMPINGS

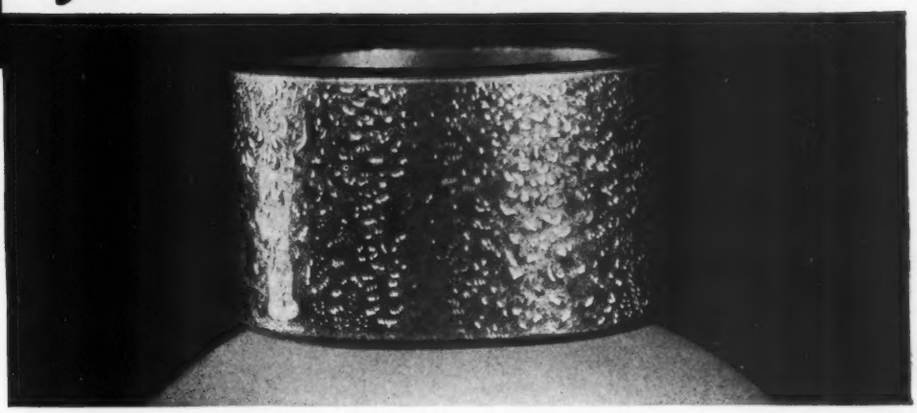
*Sales offices*

New York · Philadelphia · Chicago · Indianapolis · Detroit · Cleveland

If you have your own press equipment, let us quote on your die requirements. We have a large and modern equipped die department.

# DESIGN

# Make this test YOURSELF



## JOHNSON Ledaloyl SELF LUBRICATING BEARING BRONZE

Patent Applied For

Here is an opportunity to prove to yourself the remarkable self-lubricating qualities of LEDALOYL. Simply place a bearing on an ordinary electric light bulb. Then turn on the current and watch the heat *sweat* from the myriads of pores. Then turn off the light and watch how quickly the oil is absorbed back into the bearing.

This same action takes place in operation. The revolutions of a shaft causes a rise in temperature. The heat draws oil into the bearing area and provides a complete, protecting film to separate the shaft from the bearing.

Add to this the fact that LEDALOYL also contains both LEAD and GRAPHITE. Now you can realize why it is the ideal self-lubricating bearing — why it will operate so *quietly*, efficiently and for a longer period of time than any other similar bearing.

Write today, on your business letterhead, for a sample bearing. Make the test as outlined above. Convince yourself that here is the self-lubricating bearing you have been looking for. There is no obligation.

**FREE**

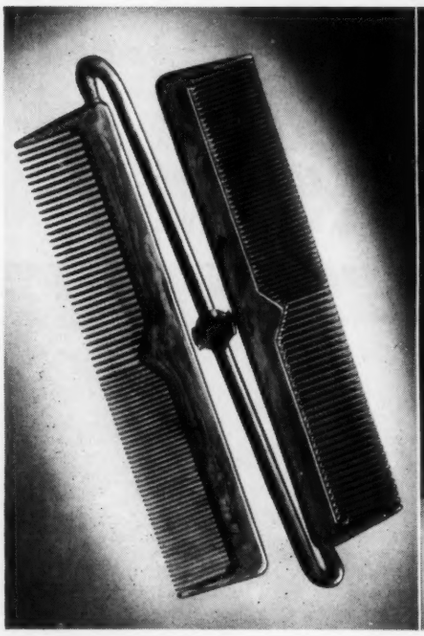
The complete story of Johnson LEDALOYL is yours for the asking — Write today for your copy — no obligation.

**JOHNSON BRONZE COMPANY**

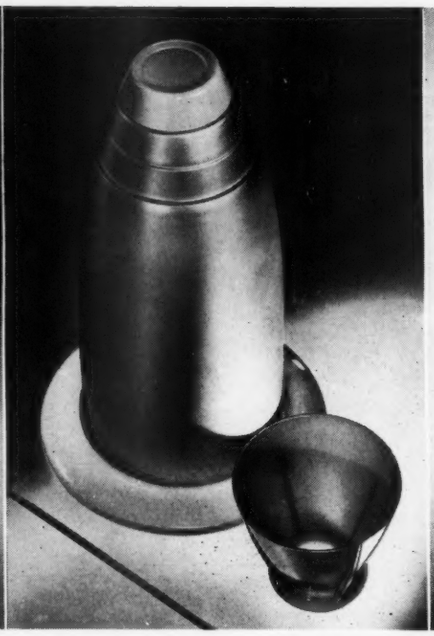
508 SOUTH MILL STREET • NEW CASTLE, PA.

Sleeve BEARING HEADQUARTERS

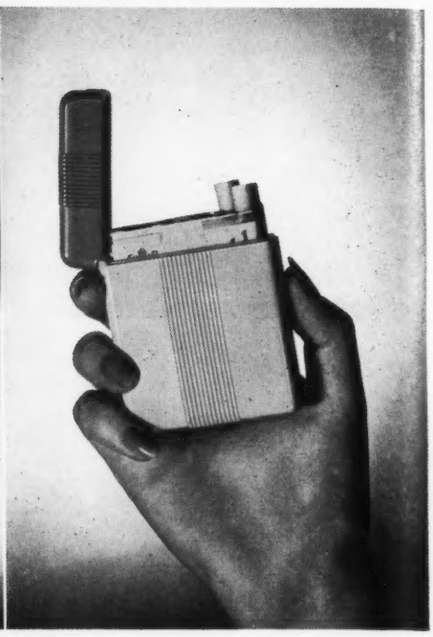
# FROM PLASTICS HEADQUARTERS—



*Hair combs in tortoise-shell effects, extrusion-molded from Bakelite Cellulose-Acetate by Ramel Mfg. Co.*



*Vacuum Carafe with cup, stopper and tray of blue Bakelite Polystyrene. Produced by Cardinal Corp. for Sears, Roebuck & Co., John Morgan, designer.*



*Pocket cigarette case in delicate ivory-color with red cap. Molded from Bakelite Urea by Rathbun Molding Corp.*

## Get a Permanently Beautiful Material

### that will *add salability* to your product

IF YOU were selecting plastics to produce the combs, vacuum carafe or cigarette case shown above, your first requirement would be *enduring beauty.* Yet, you would need a different plastic material to obtain it, in each instance!

For the Ramel Mfg. Co's. hair combs, a material of unusual toughness is essential. Bakelite Cellulose-Acetate supplies translucent beauty combined with exceptional impact strength. In contrast, the Cardinal carafe required a molded plastic that will withstand continuous exposure to moisture. Bakelite *Polystyrene* fully met this requirement. And, for the Rathbun cigarette case, Bakelite *Urea* materials furnish the required light, translucent colors and essential economies in production costs.

These are only three of the thousand-and-one instances where individual design problems have been accurately solved by an appropriate Bakelite material. Save time, assure the selection of plastics exactly suited to your needs, by consulting Bakelite Plastics Headquarters. To guide your preliminary studies, write for our Portfolio 5.

OVER 600
BAKELITE MOLDING MATERIALS
OF MANY DIFFERENT TYPES

| | |
|---|---|
| GENERAL PURPOSE | TRANSPARENT PHENOLIC |
| HEAT RESISTANT | UREA |
| LOW POWER-LOSS | CELLULOSE-ACETATE |
| IMPACT RESISTANT | POLYSTYRENE— |
| CHEMICAL RESISTANT | *and numerous others* |

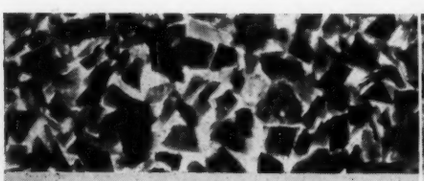
Thermo-plastic and thermo-setting materials —opaque, translucent and transparent types —colors that run the gamut of the spectrum.

BAKELITE CORPORATION, 247 PARK AVENUE, NEW YORK, N.Y.
BAKELITE CORP. OF CANADA, LTD., 163 Dufferin St., Toronto, Can. *West Coast:* Electrical Specialty Co., Inc., San Francisco, Los Angeles and Seattle

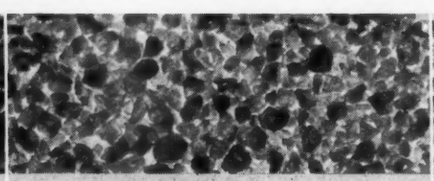
**BAKELITE**

The registered trade marks shown above distinguish materials manufactured by Bakelite Corporation. Under the symbol "B" is the material age for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products.

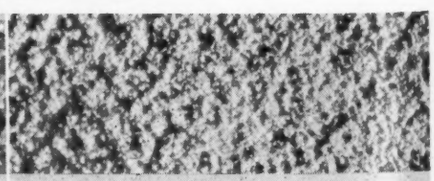
**PLASTICS HEADQUARTERS**



*Cellulose-Acetate*



*Polystyrene*



*Urea*

# How TO TAKE FULL ADVANTAGE OF PRECISION CASTING

## Manufacturer cuts costs by eliminating several complicated operations

This manufacturer makes steam turbines. Up until two years ago, assembly of the diaphragm was one of his toughest problems.

The part consists of a steel hub and rim which enclose a circular row of curved nozzle blades. Accurate assembly was essential to the efficiency of the machine but was difficult to attain due to the unusual combination of shapes. The job required several time consuming and expensive operations.

**ATTENTION DESIGNERS**

**Birdsboro's Precision Castings Permit . . .**

1. *Streamlines—with metal only where you need it functionally.*
2. *Sharp detail and smooth, accurate contours.*
3. *Marked reductions in finish metal allowances.*
4. *Use of 1/4 or 1/8 patterns for pieces having center symmetry.*

It was obvious that these operations could be eliminated provided it were possible to cast the rim in place around the blades. At the time, however, the required tolerances were so close that no foundry would accept the job for regular production.

Then the manufacturer heard of Birdsboro's new Randupson Process of Precision Casting and put the problem up to us. Frankly, we were dubious. Our customer was asking us to cast to an accuracy of +0.005—a tolerance far higher than any heretofore possible.

However, we accepted the challenge and to date have cast hundreds of these diaphragms with but two rejections. As a result, our customer has saved money and strengthened his competitive position in the turbine market.

Birdsboro's R-P Precision Castings are an ideal solution to problems of this nature. Let our engineering staff assist in applying them to your product.

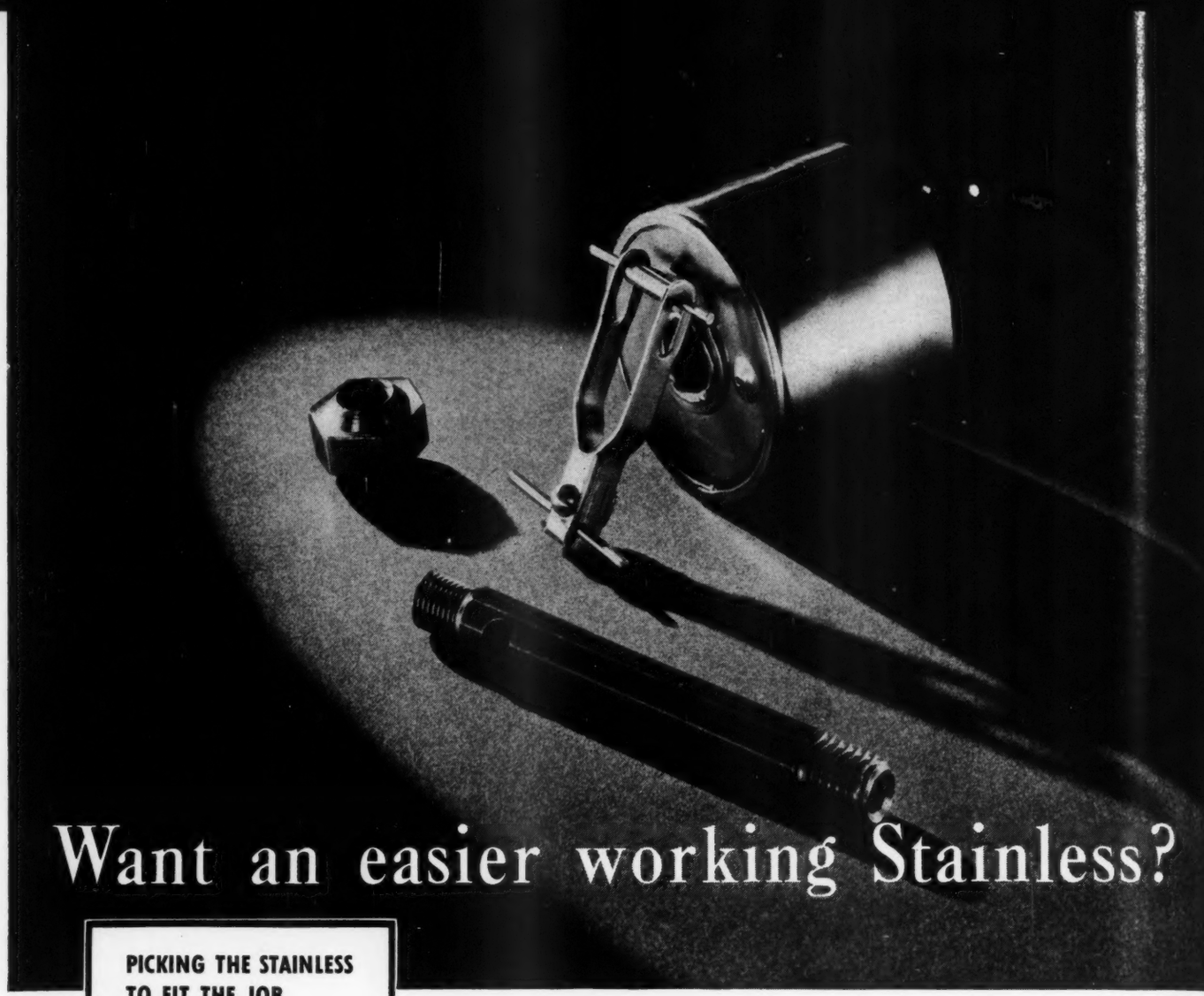
STEEL CASTINGS • STEEL MILL EQUIPMENT • STEEL AND CHILL ROLLS • HYDRAULIC MACHINERY • SPECIAL MACHINERY • CRUSHING MACHINERY

# BIRDSBORO

STEEL FOUNDRY AND MACHINE COMPANY

PLANTS AT BIRDSBORO AND READING, PENNSYLVANIA

STEEL MILL EQUIPMENT • STEEL CASTINGS • HYDRAULIC MACHINERY • SPECIAL MACHINERY
CRUSHING MACHINERY • STEEL AND CHILL ROLLS



# Want an easier working Stainless?

**PICKING THE STAINLESS TO FIT THE JOB**

On these steam trap parts, stainless was used to resist the erosive and corrosive action of high pressure and temperature steam. Hexagonal bolt and nut and 2 small pins are of Carpenter Stainless No. 5 for free-machining. Bucket, clevis, and bracket lever were formed without trouble from Carpenter Stainless Strip No. 4.

**HERE'S A SUGGESTION.** Try Free-Machining Stainless. You can give your product all the advantages of stainless and still keep costs within reason.

Ten years' experience with this alloy since its announcement by Carpenter in 1928 has shown that Free-Machining Stainless . . .

- *Can be machined with standard shop tools at speeds 50% to 100% faster than ordinary stainless steels.*
- *Can be ground at approximately half the cost.*
- *Has corrosion and heat resistance characteristics comparable to any other 18-8 or 14% chromium steels.*

THE CARPENTER STEEL COMPANY

*Carpenter* FREE MACHINING

**FREE-MACHINING STAINLESS ENHANCES YOUR PRODUCT** ...gives you new and potent sales arguments. In addition, its production economies permit wider use of stainless for utility purposes.

In the examples illustrated, the manufacturers obtained smooth, fine finishes and good corrosion resistance with Carpenter Stainless No. 5, a 14% Chromium type. Where super-corrosion resistance was needed, Carpenter No. 8, a Free-Machining 18-8 type containing Selenium, was used. These two Carpenter steels are made under the rigidly controlled conditions of a tool steel mill. In your plant their uniform, easy working qualities show up in reduced costs and fewer headaches.

A Carpenter representative, trained in keeping stainless production costs down, will be glad to help you apply Free-Machining Stainless to your product. Or, if you prefer, mail the coupon below for Carpenter's handy Slide Chart. A complete summary of technical data on *all* stainless steels, it helps you select the right stainless quickly. It will be sent you without obligation.

more than corrosion resistance

**AUTOMATICS TURNED OUT THIS AIRPLANE PART**

Machined from Carpenter Stainless No. 8 bar stock, this airplane part indicates what can be done with Free-Machining Stainless. Notice the nice form cutting and end bore. This part is shown actual size.

**"AND THEN WE TRIED CARPENTER STAINLESS NO. 8"**

First steel, then brass, then a copper nickel alloy was used in this flow valve. The first two failed by corrosion. The third was too hard to drill. Now a 1¼" bar of Carpenter Free-Machining Stainless No. 8 is bored out and the small side orifice brazed to the tube to form the side connection. "Complete satisfaction," reports the customer.

READING, PENNA.

# STAINLESS STEELS

**THE CARPENTER STEEL COMPANY**
**117 W. BERN STREET, READING, PA.**

Please mail me, without obligation, your Free Pocket-Size Slide Chart giving me information on Stainless Steels.

NAME_____

FIRM_____
(Firm name must be given)

ADDRESS_____

CITY_____ STATE_____

# FULL INFORMATION on CRAMP ALLOYS

## YOURS for the ASKING

### SUPER-STRENGTH BRONZE

Tensile Strength 110,000 lbs. per sq. in., minimum
Yield Point ... 55,000 lbs. per sq. in., minimum
Elongation .... 10% in 2 inches, minimum

Recommended for heavy duty slow moving loads or for parts requiring great strength.

### P-M-G METAL

Tensile Strength. 45,000 lbs. per sq. in., minimum
Yield Point.... 22,000 lbs. per sq. in., minimum
Elongation .... 15% in 2 inches, minimum

A silicon bronze containing no tin—recommended for high contact speeds, medium to heavy loads and resistance to a number of acids.

### ELFUR IRON

Tensile Strength up to 55,000 lbs. per square inch
Brinell Hardness up to 400

A group of Electric Furnace alloys containing chromium, molybdenum, copper and nickel. Excellent wearing quaiities, good acid resistance, high strength.

Folders containing complete information on the above metals and their various uses are available for distribution. We will be pleased to send you copies of each or all of these—also, if you wish, the complete reference catalog of Cramp's Alloys of Brass, Bronze and Iron. Fill in the coupon below and mail at once.

**CRAMP BRASS & IRON FOUNDRIES CO.**
**Subsidiary of Baldwin Locomotive Works**
**Paschall Station**
**PHILADELPHIA, PA.**

**CRAMP BRASS & IRON FOUNDRIES CO., Paschall Station, Philadelphia, Pa.**

Gentlemen:—
Kindly send me bulletins on (please check those desired) ☐ Super-Strength Bronze, ☐ P-M-G Metal, ☐ Elfur Iron, ☐ your complete reference catalog for engineering purposes.

NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... STATE .....

# A NUMBER OF PEOPLE HAVE ASKED US—

# *Why the name "Felters"*

WHEN THE FELTERS COMPANY, INC. was founded thirty years ago, every individual involved was active in the felt industry, and would be active in the new firm. "FELTERS" are individuals who make felt, so therefore the name "THE FELTERS COMPANY, INC." (a company belonging to a group who actually made felt) was a logical choice.

Look for the Felters Certified Felt label on the felt that you buy.

"FELT BY FELTERS"

●

THE FELTERS COMPANY INCORPORATED, 210 South Street, Boston, Mass.

OFFICES AT NEW YORK, CHICAGO, PHILADELPHIA, DETROIT, ST. LOUIS, DALLAS, SAN FRANCISCO

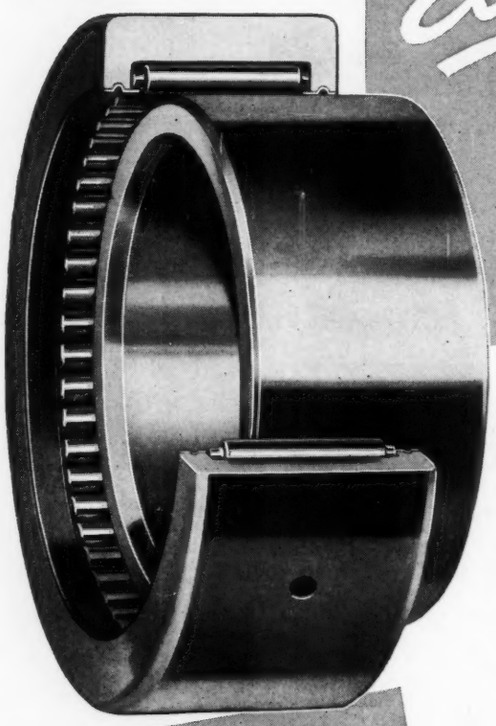
MILLS AT JOHNSON CITY, NEW YORK • MILLBURY, MASSACHUSETTS • JACKSON, MICHIGAN

# New Type — BANTAM QUILL BEARING!

## Excels WHERE LOADS ARE HEAVIEST

## WHERE RELIABILITY IS PARAMOUNT

## WHERE LOWER COSTS ARE ESSENTIAL



**WIDE RANGE OF SIZES CARRIED IN STOCK!**

HERE'S the answer to your need for a bearing which takes less space, has high load capacity, yet sells at a low price. Bantam Standard Series Quill Bearings are the result of years of pioneering in the production of Quill and Needle Bearings and offer many advantages. Design has been greatly simplified. No fragile parts, thereby avoiding possibility of failure. End Thrust is taken on ribs of the one-piece channel-shaped outer race.

Bantam Standard Quill Bearings are available for immediate delivery in shaft sizes from ½" to 5".

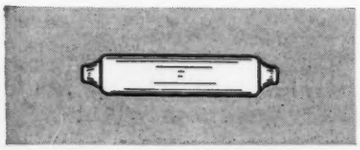
Full Engineering Data on Bantam Standard Series Quill Bearing is available. Send today for Bulletin 103R.

For Needle Bearings to be used in lighter service request Circular 19A from our affiliate, The Torrington Company, Torrington, Conn.

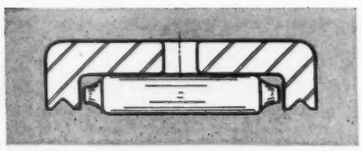
**BANTAM BEARINGS CORPORATION**
**SOUTH BEND, INDIANA**
Subsidiary of THE TORRINGTON CO.
Torrington, Conn.

**BANTAM BEARINGS**

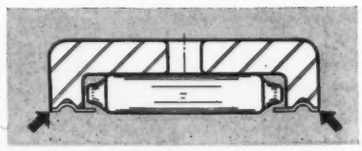
**A complete range of sizes for shafts from ½" to 5" diameter is carried in stock ready for immediate shipment. Available with or without inner races.**



Correctly proportioned rollers with husky curvilinear trunnions eliminating high stresses on trunnions. Accurately hardened and ground for long life.



One-piece channel-shaped outer race. Rigid surfaces all accurately hardened and ground providing solid abutment for end of roller. Assures longer bearing life.



All fragile parts have been eliminated. Simplified method for definite roller retainment. Function of the retaining band is completed when bearing is assembled.

**TAPERED ROLLER • • • STRAIGHT ROLLER • • • BALL BEARINGS**

Advertisement

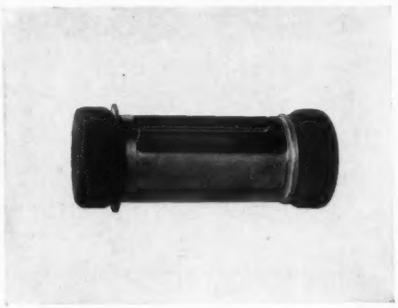
# COPPER ALLOY BULLETIN

*Reporting News and Technical Developments of Copper and Copper-Base Alloys*

DECEMBER — "Bridgeport" Brass Co. — 1938

## DURONZE SELECTED FOR USE IN GROVER CASH CARRIERS

The Grover Company, makers of cash carriers, found in the high strength of Duronze* II the solution for an unusual manufacturing problem. A longer opening was needed in the shell to accommodate sales checks and alteration tags, but the overall length of the carrier could not be increased because of operating requirements of carrier systems which involve short turning radii and right-angle bends at many points along the conveyors.



When the longer opening was cut in the standard brass shell, it was weakened so much that it easily became distorted. By substituting Duronze II for brass, it was possible to increase the length of the opening and retain ample strength, for Duronze II, in addition to the ductility of copper and the endurance of fine bronze, possesses the strength of steel. Duronze II does not become brittle when hard worked, and is resistant to season cracking. By making the shells a trifle longer than standard and folding back the extra length, The Grover Company produced shells of much greater strength than previous designs, while the carriers remained fully interchangeable with other types.

### Properties of Deoxidized Copper

Recent investigations indicate that deoxidized copper may have definite advantages over tough-pitch copper when cast in shapes intended for the rolling mill. According to reports of the American Institute of Mining and Metallurgical Engineers, comparisons were made between a sample of the ordinary type of wire bar cast horizontally in an open mold and a sample of deoxidized copper cast in a vertical mold. Plastic characteristics of the deoxidized copper were apparently superior.

## PERIODIC CHECK OF METAL SPECIFICATIONS PREVENTS PURCHASING OBSOLESCENCE

In an era in which the problem of obsolescence is receiving increased attention, far-sighted manufacturers are aware that obsolescence may enter into the purchase of raw materials under outmoded specifications as well as into the production process. For this reason many fabricators have recognized the advisability of instituting a periodic check of these specifications.

Two chief factors contribute to the possibility of obsolescence in metal purchases —changes in production methods, and the introduction of new alloys. In the production process, rapid improvements in equipment and methods of fabrication may radically change the requirements for the metal used, even though the finished product remains superficially the same. Moreover, even though no major changes take place in production, the steady development of new alloys has resulted in a considerable expansion of the metals available.

#### Knowledge of Metals Involved

A check-up of metal purchasing specifications, in order to insure both maximum quality and economy, should therefore be made with a full consideration of all the factors involved. Most important among these factors are the types of fabricating process used and the type of service to which the product will be subjected. The successful execution of such a survey requires not only a knowledge of the demands made upon metals by fabricating and service requirements, but also a comprehensive understanding of the characteristics of the metals themselves.

Many manufacturers find it advisable to supplement their own intimate knowledge

*(Continued on Following Page)*

### Non-Fuming Welding Rod Produces Strong Welds†

Bridgeport's Welding Rod No. 192 has special advantages in the welding process because of its non-fuming properties. The rod is manufactured of manganese bronze to which a small amount of silicon has been added. The silicon content produces the non-fuming quality. In addition, it has a fluxing action which results in the formation of sounder metal and hence of stronger welds than can be obtained with ordinary types of welding rods.

The rod flows smoothly during the welding process, and produces a clean, bright weld, free from the black manganese dioxide film that is sometimes formed by rods high in manganese content.

†*Mfd. under U. S. Pats. Nos. 17,631 and 1,525,058.*

The extensive testing facilities of the Bridgeport laboratories are available to assist manufacturers in modernizing their metal specifications.

**PREPARED EACH MONTH BY THE BRIDGEPORT BRASS COMPANY**

*Headquarters for Brass, Bronze and Copper*

# COPPER ALLOY BULLETIN

## NEW DEVELOPMENTS

**This column** lists items manufactured or developed by many different sources. Further information on any of these items may be obtained by writing the Bridgeport Brass Company, who will gladly refer readers to the manufacturer or other source.

**A new welding cable** provides a water-cooled connection between secondary taps of transformer and portable welding gun. It consists of a central rubber core around which are helically wound flexible, tinned copper cables. Leads of opposite polarity are separated by a corrugated live rubber spacer. The construction permits circulation of the cooling water through the core. Outer cover is a flexible rubber tube, reinforced with wire and woven fabric.

**Exhaust equipment** for grinding and polishing machines consists of a pair of hoods, pipe connections, and motor-driven blower. A filter can be connected to the delivery side of the blower to collect the dust, permitting only clean air to escape.

**A metal-working lathe** provides spindle speeds ranging from 40 to 1,200 RPM., cuts screw threads from 4 to 112 per inch, and has power longitudinal turning feeds of 0.002 to 0.015 inch. It is said to be especially suitable for machining very small diameter parts of brass and other metals.

**A brazing torch** is suitable for light brazing, soldering, and for heating copper pipe fittings in sizes to ¾ inch. It produces a brush-type blast flame ranging from 3 inches in length and ⅜-inch diameter to 8 inches by ¼-inch. Temperatures up to 2,500 degrees F. can be obtained. The torch operates on compressed gas supplied in small cylinders by the manufacturer of the torch.

**A sanding machine** is said to impart a gyratory motion which approximates hand sanding, and is suitable for finishing lacquer or other coats on metal surfaces. Unit consists of a ¾-horsepower motor mounted on caster-equipped stand, with a flexible shaft for transmitting power to the tool head.

**A new scleroscope** is pocket-size and weighs only one pound. Hardness is measured by a diamond-pointed hammer which rebounds after striking the work; height of the rebound is indicated by a dial which records the hardness of the metal.

**A combination instrument** includes a metallurgical microscope and camera assembled into one permanently aligned unit. The camera is equipped with a device that changes the magnification of eye-piece by turning a dial. Stage of the microscope is of the inverted type and accommodates polished or fractured specimens of apt shape. Exact standard magnifications for grain size estimations are readily obtained.

**A spot welder** is designed to handle medium-duty welding of sheet metal. Pressure and current are applied by a foot-treadle. Welding current is controlled by means of a heavy-duty switch.

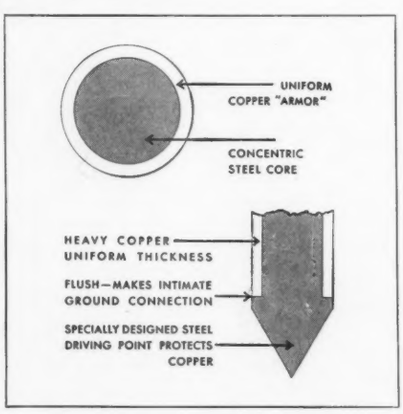
## METAL SPECIFICATIONS

*(Continued from Preceding Page)*

of their production processes and service requirements by the knowledge of metals possessed by a skilled metallurgist. Metallurgical assistance in the making of surveys of metal specifications is an important part of the service to customers which is made available by Bridgeport's extensive laboratory facilities and skilled engineering staff. In addition to original research work in the properties of existing metals and the development of new alloys, the laboratories at Bridgeport are equipped to serve as an important adjunct to the fabricator's own facilities, by studying the suitability of metals of various compositions and tempers to specific requirements.

## Copper Ground Rods Resist Rust

Bridgeport Copper Ground Rods, made with a thick, uniform "armor", of copper around a strong steel core, are extensively used in applications requiring grounding for protection, particularly in soil that is moist or has been treated to reduce ground resistance. The copper "armor" gives long life in places in which unprotected rods rust quickly.


UNIFORM COPPER "ARMOR"
CONCENTRIC STEEL CORE
HEAVY COPPER UNIFORM THICKNESS
FLUSH—MAKES INTIMATE GROUND CONNECTION
SPECIALLY DESIGNED STEEL DRIVING POINT PROTECTS COPPER

Bridgeport Copper Ground Rods have a point specially designed for easy driving. The construction of the point protects the copper against damage when the rod is driven into the ground, and gives highly efficient electrical contact.

Line Material Co. is national distributor for Bridgeport Copper Ground Rod.

## ALLOYS OF COPPER

Many readers of the COPPER ALLOY BULLETIN have requested the publication of detailed technical information on the various copper alloys. In response to these requests, we are initiating with this issue a series of articles on the composition, physical properties, fabricating processes, and product applications of the more important copper alloys. Each of the alloys will be treated in one or more articles.

### COMMERCIAL BRONZE

*Commercial Bronze* is an alloy consisting of 90% copper and 10% zinc. From the metallurgical standpoint, the use of the term "Bronze" is questionable, because this term properly applies to an alloy containing tin, but the industry has used the name "Commercial Bronze" for so long a time that it has become well established. There are numerous modifications of this alloy, which, while they are not truly Commercial Bronzes, are so similar that they are included in the same class.

The following physical characteristics apply only to the 90-10 alloy. Any modification in the composition will of course produce changes in the physical properties also:

Analysis . . . . . .90% copper, 10% zinc
A.S.T.M. Specifications . B36-38T, Sheet
Modulus of Elasticity,
15,000,000 lbs. per sq. in.
Density . . . . . .318 lb. per cu. in.
Coefficient of Linear Expansion,
0.0000175 per deg. C. (25-100 C.)
Electrical Conductivity,
43% (Copper 100%)
Thermal Conductivity,
47% (Copper 100%)

#### General Characteristics

Commercial Bronze is somewhat stronger than copper and has equal or better ductility. The structure of the alloy consists of uniform copper and zinc atoms in solid solution. This type of structure produces a ductile metal that is suitable for cold working and forming operations, but not for machining.

The subject of Commercial Bronze and its modifications will be concluded in next month's issue.

*The services of the Chemical and Metallurgical staff of the Bridgeport Brass Company are available to customers for the solution of problems pertaining to their metal requirements.*


**PRODUCTS OF THE BRIDGEPORT BRASS COMPANY**

*Executive Offices: BRIDGEPORT, CONN.— Branch Offices and Warehouses in Principal Cities*

**SHEETS, ROLLS, STRIPS**—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

**CONDENSER, HEAT EXCHANGER, SUGAR TUBES**—For steam surface condensers, heat exchangers; oil refineries, and process industries.

**PHONO-ELECTRIC* ALLOYS**—High-strength bronze trolley, messenger wire and cable.

**WELDING ROD**—For repairing cast iron and steel, fabricating silicon bronze tanks.

**LEDRITE* ROD**—For making automatic screw machine products.

BRASS "Bridgeport" CO.

*Established 1865*

**COPPER WATER TUBE AND FITTINGS**—For plumbing, heating, underground piping.

**DURONZE ALLOYS**—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

**BRASS, BRONZE, DURONZE WIRE**—For cap and machine screws, wood screws, rivets, bolts, nuts.

**FABRICATING SERVICE DEPT.**—Engineering staff, special equipment for making parts or complete items.

**BRASS AND COPPER PIPE**—"Plumrite"* for plumbing, underground and industrial services.

*Trade-name.

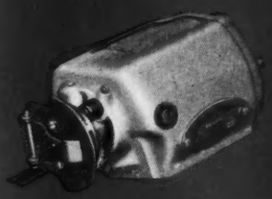
**BRIDGEPORT BRASS**

Shaded-pole motor, 3.5, 5, and 12 watts, 110 and 220 volts, 1550 rpm

Series motor, 1/100 to 1/3 hp, for voltages up to 250

Gear-motor for loads up to 8 oz-ft; gear ratios vary from 41 to 1050:1

# Little Motors for Your Devices



Governor-controlled motor for calculating machines and other constant-speed applications

Flange-mounted motor used on recording instruments

Three-lug mounting for small propeller fans

Hair-dryer motor, enclosed, has long life and operates quietly

HERE is a complete line of motors for unusually small devices—sturdy and with plenty of output for the applications below. General Electric has standard motors for most applications and can furnish them for round-frame, end-shield, or foot mounting, or without end shields for building into your device. They are supplied with sleeve or ball bearings and with open or closed end shields.

If you are building a new device, G-E engineers will be glad to work with you on the motor application—to help you select a motor to fit exactly the requirements of your device. Contact the nearest G-E sales office or write to General Electric, Schenectady, N. Y.

If you would like additional information on these motors, write for Bulletins GEA-1844A on shaded-pole motors and GEA-1942A and GEA-1988A on small series motors.

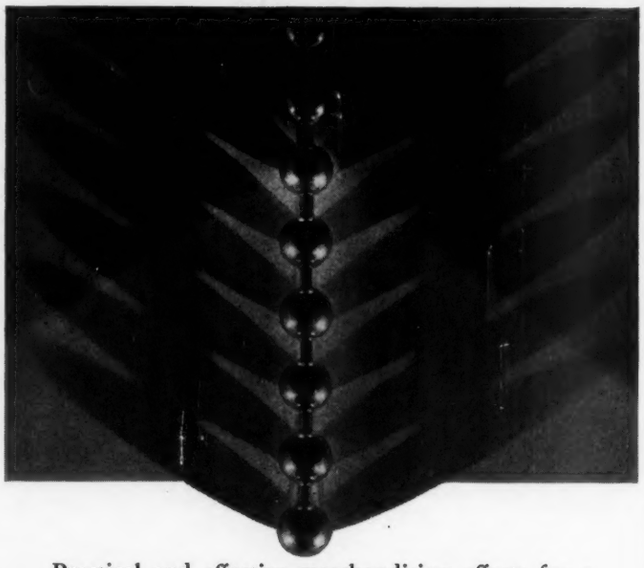
## APPLICATIONS

**Adding machines**
**Advertising devices**
**Bookkeeping machines**
**Bus heaters**
**Calculating machines**
**Check protectors**
**Control equipment**
**Domestic devices**
**Grinders**
**Hair dryers**
**Hedge trimmers**
**Laboratory devices**
**Motion-picture projectors**
**Perforators**
**Postage machines**
**Propeller fans**
**Sewing machines**
**Sirens**
**Ticker-tape pullers**
**Time recorders**
**Typewriters**

GENERAL ELECTRIC

070-340

# INGENUITY



Practical and effective merchandising effects for a product can often be obtained by the introduction of BEAD CHAIN* in brilliant metal finishes, as for example, to hold a detachable cap.

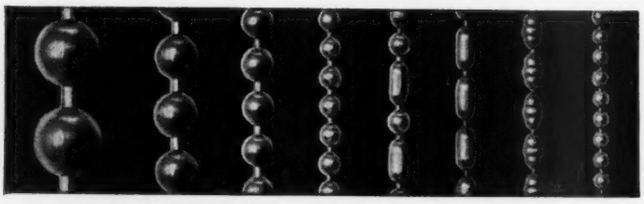
## BEAD CHAIN*

is a series of perfect swivels, strong and non-kinkable. We have many attachments and couplings that give it unusual value in product construction and design.

BEAD CHAIN

Trade Mark Reg. U. S. Pat Off.

BEAD CHAIN* is made in the sizes and shapes shown below, of various metals and in many finishes.



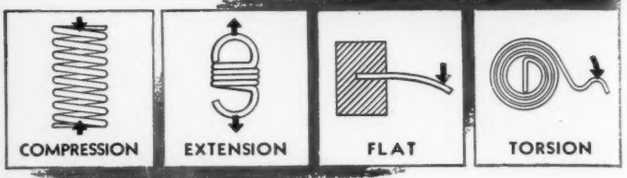
Our engineering department is prepared to cooperate fully with designers and manufacturers in developing economical and effective uses, assemblies and units of BEAD CHAIN* for their products.

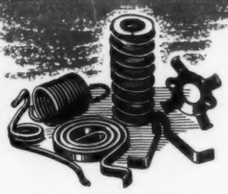
**THE BEAD CHAIN MANUFACTURING CO.**

62 Mt. Grove St. Bridgeport Conn.

*Reg. U.S. Pat. Off.

# B·G·R helps you to get the right SPRING ACTION



SPRING ACTION that is designed especially to meet the demands of your mechanism will give the best result in performance and length of service.

It will pay you to consult with B-G-R spring engineers on the space to allow, the kind of metal to use, and the size of spring desirable for the load involved.

Take the B-G-R short-cut towards minimizing your experimental time and expense. And when the time comes to produce the order, the complete facilities of two plants are at your disposal, for continuous large production . . . . or for very small orders.

**BARNES-GIBSON-RAYMOND**

DETROIT PLANT — DIVISION OF ASSOCIATED SPRING CORP. — COOK PLANT

DETROIT, MICHIGAN ← TWO PLANTS → ANN ARBOR, MICHIGAN

*Model "B"*

**2 H.P. at 2300 to 2700 R.P.M. (over 25% reserve power)**

Standard equipment includes: oil-bath air cleaner, gasoline filter, specially designed dust and moisture-proof high tension flywheel magneto, compression release on crank starter models, gasoline tank and fittings, screened blower housing, muffler.

Special "B" types available: 4 to 1 or 6 to 1 gear reduction drives; direct mounting crank cases, machine faced and tapped with crankshaft in ball bearing on drive side; higher speeds with increased power output; light weight; automatic plain or ball bearing pulley clutches, etc.

For every job requiring gasoline power in the ½ to 5 H.P. range, choose Briggs & Stratton 4 cycle, air cooled gasoline motors. The world's finest small motors, endorsed by more manufacturers than any other make. Briggs & Stratton gasoline motors provide improved performance, greater saleability, added value to your machines and equipment. We are glad to supply complete detailed specifications on the various models, together with descriptions and feature details.

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Milwaukee Wisconsin

THE NEW RAND SHAVER, BY GENERAL SHAVER DIVISION, REMINGTON-RAND, INC.

**For what types of products may Plaskon housings be used?** Radios, vacuum cleaners, shavers, scales, clocks, timers, mixers, thermostats, etc.

**Is there any limit to the size of Plaskon housings?** Existing presses can produce one-piece housings up to 24″ x 24″ x 16″ deep, while sectional housings can be made considerably larger.

**What are the advantages of Plaskon housings?** Lighter weight (Plaskon is about half as heavy as aluminum), extremely attractive appearance, ability to take shapes and sections impossible in metal stampings.

**Is Plaskon an insulator?** Yes. It has a high dielectric strength, eliminates all danger of shocks or electrical losses.

**What about colors?** Plaskon is available in a complete range of colors, pastels and pure hues, ranging from black to snowy white.

**Do they fade?** No. Plaskon colors are light-fast and do not yellow.

**Why do you stress Plaskon's surface?** Because Plaskon's sleek, warm finish appeals strongly to the sense of touch, helps close sales.

**Is this finish durable?** Yes, Plaskon's finish is part of the piece, cannot chip, peel, stain, check or wear off.

**What about heat?** Plaskon withstands continual exposure to temperatures up to 167°F.—occasional exposure much higher. Plaskon cannot soften, even at high temperatures.

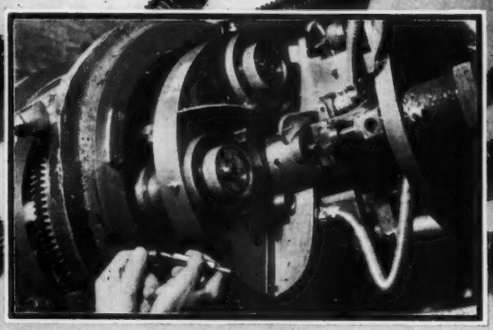
**Answers to many more questions about Plaskon* will be found in a new 32 page illustrated book we have just published. For your free copy, write Plaskon Company, Inc., 2120 Sylvan Ave., Toledo, O.**

*REG. U. S. PAT. OFF.

MOLDED **PLASKON** COLOR

**PLASKON COMPANY, INC., 2120 SYLVAN AVE., TOLEDO, OHIO**

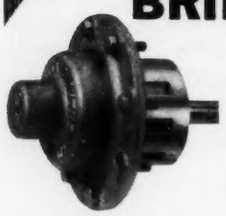
# ALLEN HOLLOW SCREWS



Nobody punishes hollow screws like the testers in the Allen laboratory. When they get through with an Allen screw, it goes through every test in your shop with a higher factor of safety than most *machine parts.*

THE ALLEN MFG. COMPANY
HARTFORD, CONN. U.S.A.

## WHERE QUIET BRINGS RESULTS



Yes . . . you need quiet pump performance for results, too. That's why our engineers have designed Tuthill "Stripped Pumps" for quiet operation. Remember—you can save space, reduce cost and improve appearance by building the pumping elements directly into the design of your machine with Tuthill "Stripped Pumps." Capacities up to 50 g. p. m.

*Write for "Stripped Pump" Catalog Today*

**TUTHILL PUMP COMPANY**
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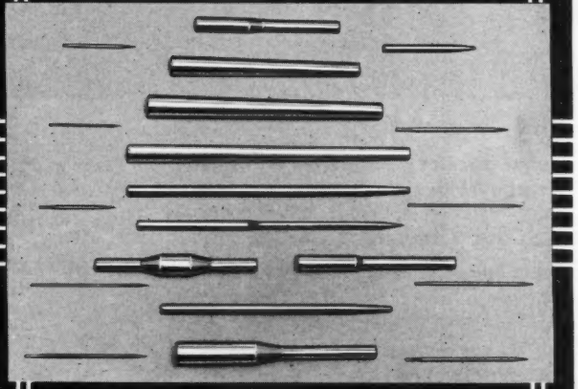
## MADE TO ORDER



Tubes, Rods, Wire reduced by rotary swaging to your specifications by the pioneer rotary swaging machine builder.

Cuts show various tubes reduced, tapered and closed on end by swaging. Solid work up to 5/8" diameter and medium wall tubing up to 2 1/2" O. D. can be handled.

You benefit from our nearly seventy years' rotary swaging experience.

*The Torrington Company*
SPECIALTY DEP'T.
Torrington, Conn., U.S.A.

# There was a Fable about a Fluid

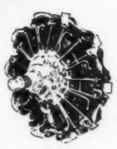
They said it couldn't be filtered. It was so viscous that it clogged a screen after 12 minutes of flow. How could a *filter* handle it?

Best answer to that is to have a *continuously cleanable* filter that will not clog, because it *can not*. Cuno Filters clean themselves; and on this job they worked so well we've had another order.

What kind of fluid have you? What kind of solids are in it? Is it water, oil, gas, air, acid, coolant, paint—name it . . . and we'll name a type and size of Cuno to strain it. There'll be no delays in your production for filter cleaning. There'll be no necessity for duplex (double-expense) mountings.

A glance at that column on your left will give you more *ideas*. For your convenience in getting *information*, there's a coupon below. Will you send it today?

Cuno's types of continuously cleanable filters — Auto-Klean and Flo-Klean have many sizes, strain two or three gallons per minute — or many thousand gallons. Made in any corrosion-resistant machinable metal, they operate over wide ranges of temperature, viscosity, and pressure; and they are all adaptable to special jobs. Our engineering service and laboratories are at your disposal, of course.



To be specific: One aircraft engine uses a Cuno filter 1¼" in diameter by 5½" long. .0035" spacing. Rating —60 lbs. per minute, 60 SAE oil at 160° F. In the design stage of engines and machines, engineers like to work with Cuno to make the filter an integral part — not just an "extra attachment."

All headstock gears in Pratt & Whitney's new Model "C" lathe run in oil constantly — and are Cuno protected. We supply the filter cartridges. Pratt & Whitney build their own casings, make their own permanent filter attachment.

—or perhaps you're interested in filtering hydraulic oils? Many and many an installation has Cuno in this field. Our experience could well be utilized by you in the early stages of your drafting.

One automotive manufacturer used kerosene as a coolant on his grinders. Cuno filters worked so well on this that the company ordered more filters for another grinding job where soda water was the coolant. On what kind of a job can we help *you?*

**See our exhibit at the Thirteenth National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York, December 5 to 10, 1938.**

Cuno Engineering Corporation
687 South Vine Street
Meriden, Connecticut.
Please send me free bulletins on Cuno filters

Name ..... State .....
Company ..... City .....
Street .....
☐I'm interested in your engineering service.
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*call* **CUNO** *your filtration engineers*

CUNO ENGINEERING CORPORATION ★ MERIDEN, CONNECTICUT

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So highly individualized has the rapid and widespread use of plastics become that Richardson devotes its entire time and resources to the plastics arts, offering to industry an organization with comprehensive production facilities and technical abilities to assist in the application of INSUROK and other plastics to products old and new, and to manufacturing equipment. Learn about the breadth and scope of this unusual Richardson service—and how it can be used to your profitable advantage.

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### *Superior Laminated or Molded Plastic*

. . . of known physical, chemical and dielectric characteristics, is available in sheets, rods and tubes, in sizes and gauges, colors and finishes to meet your fabrication requirements, or finished products ready for assembly. Investigate INSUROK, the superior plastic. Literature on request.

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New Brunswick, N. J. Indianapolis, Ind.
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ALL STYLES
ANY SIZE
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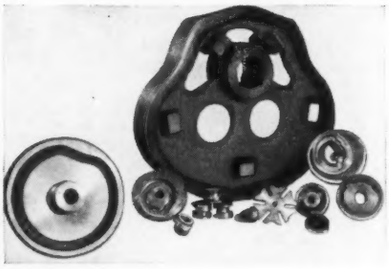
ALSO GENEVA MOTIONS



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MASTER CRAFTSMEN IN METAL

*for* DECORATED METAL PRODUCTS
OF UNUSUAL BEAUTY AND ACCURACY
VOLUME PRODUCTION TO THE MOST EXACTING SPECIFICATIONS

*Write or wire Dept. 394.*

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# DEPENDING ON EVERLOCKS

The amazing locking-quality of Everlock washers to resist vibration makes them the outstanding choice of industry and transportation.

In addition to powerful spring tension, Everlock's patented tooth construction gives you an extra margin of safety by positively locking your assembly.

**THOMPSON-BREMER & CO.**
**1642 WEST HUBBARD STREET, CHICAGO**

*Other Washers Have Been Tried* *Now Everlocks are Specified*

# LEROY LETTERING LENDS DISTINCTION TO YOUR DRAWINGS . . .

Accurate, uniform lettering—done with speed and ease—that is Leroy's contribution to the finished appearance of your drawings.

A Leroy set consists of patented templates, a simple scriber and foolproof, tubular pens. Each template produces both vertical and slanting letters and numerals. Complete, finished letters are formed in one operation. No guide lines, no preliminary roughing in. The work is performed well above the template, in full view of the operator; there is no danger of smearing when the template is removed.

There are templates and pens of all sizes—sold singly or in sets. You make your selection to fit your own standards and requirements. Prices are moderate.

Add Leroy lettering to your drafting room equipment. Your K & E dealer will be glad to arrange a demonstration—or write us for Booklet No. 43 and price list.

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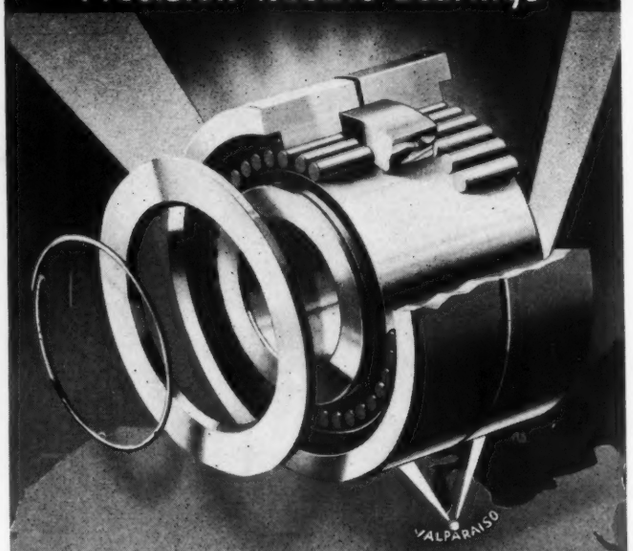
# Industry Runs On
Mc GILL
*MULTIROL*
Precision Needle Bearings




*The Original Needle Type Bearings*

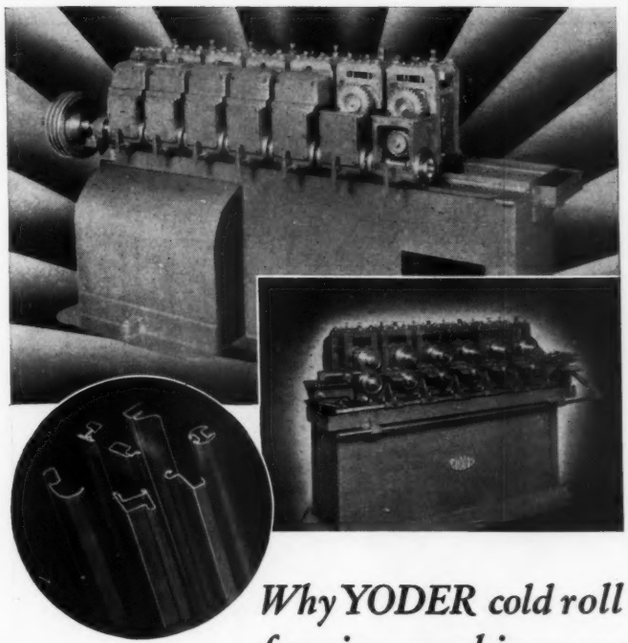
U.S. Pat. No. 1,985,693

THE great load capacity of McGill *MULTIROL* Precision Bearings in limited space is revolutionizing radial bearing practice in machine design throughout the industry.

Since their introduction by McGill eight years ago, *MULTIROL* bearings have definitely proved their ability to far outrun plain bearings, and frequently other anti-friction types, in a wide variety of uses—especially under sustained heavy or intermittent shock loads. Investigate *MULTIROL* adaptability to equipment you design or build. *MULTIROL* bearings are stocked in a wide variety of standard sizes from ⅝ to 6-inch bore, single and double rows of rollers, at low, volume production prices. Corrosion and heat resisting types and special designs engineered to individual needs.

*Send for Bulletin No. 37*

**McGILL MANUFACTURING CO.**
Bearing Division, 1450 N. Lafayette St.
VALPARAISO, IND.



*Why YODER cold roll forming machines use*

# OHIO GEARS

Perfect uniformity of product . . . precision of cut . . . smooth operation . . . speed to suit demands . . . long life . . . those are but a few of the specifications which all Yoder Cold Roll Forming Machines must meet. So Yoder Engineers check and recheck each part. They know, for instance, the responsibility placed on the power transmission. So, in their selections, they choose gears they know will help them meet those specifications. They look too, for another factor—*quick, reliable service* from the gear cutter.

That's why Ohio Cut Gears are standard on so many machines bearing the famed Yoder trade-mark.

You too, may find Ohio Gears a profitable answer to a gear problem. Whether you design or maintain machinery, you'll find their advantages well worthwhile. Investigate Ohio Gears, (stock or special,) Ohio Speed Reducers and Power Transmission Equipment for your own needs. Write today.

**THE OHIO GEAR CO.**
**1325 E. 179th Street • Cleveland, Ohio**

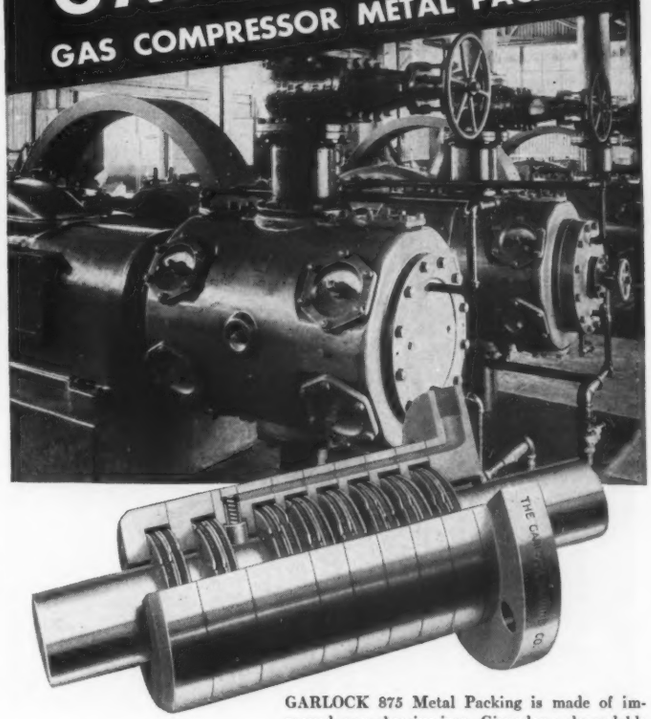
*Representatives*

*Los Angeles, Calif. J. W. Minder Chain & Gear Co., 927 Santa Fe Avenue.
*San Francisco, Calif. Adam-Hill Co., 244-246 Ninth Street.
Indianapolis, Ind. A. R. Young, 518 North Delaware Street.
Louisville, Ky. Alfred Halliday, 330 Starks Building.
Detroit, Mich. George P. Coulter, 322 Curtiss Building.
Madison, Wisconsin. M. Ratclif, Shorewood Hills.
Buffalo, N. Y. F. E. Allen, Inc., 2665 Main Street.
New York City, N. Y. Patron Millwright & Transmission Co., 154-156 Grand Street.
New York City, N. Y. E. G. Long Co., 50 Church Street.
Grand Rapids, Mich. W. H. Slaughter, 419 Oakdale St., S. E.
New England. George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
Pittsburgh, Pa. Industrial Sales & Engineering Co., Box 8606, Wilkinsburg, Pa.
Salt Lake City, Utah. A. O. Gates, 619-629 South Fifth West Street.
*Stocks carried.

**OHIO GEARS**

# GARLOCK 875

## GAS COMPRESSOR METAL PACKING



GARLOCK 875 Metal Packing is made of improved, non-abrasive iron. Gives long, dependable service on high or low stage gas compressors.

# IMPROVED! FOR LONG SERVICE

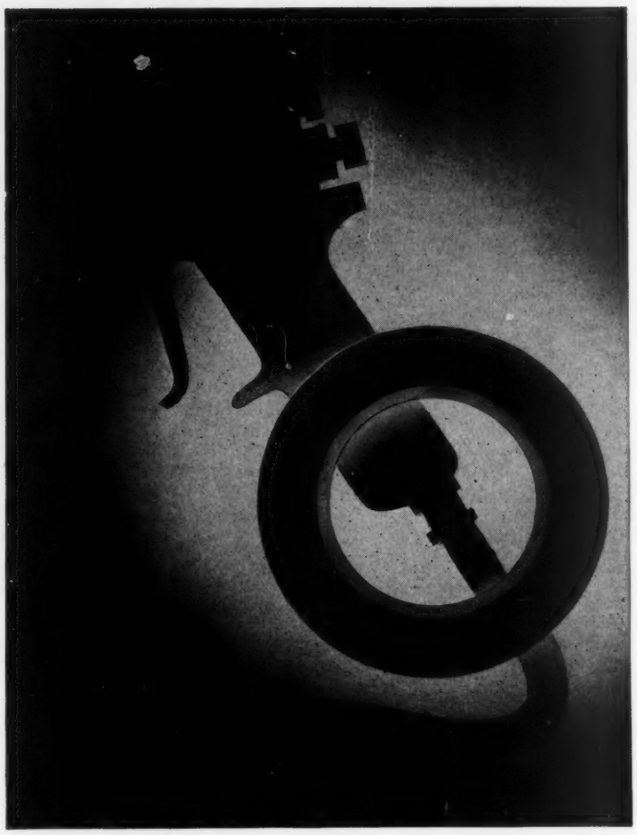
New metals and new processes are enabling progressive manufacturers to build greater wear-resistance and longer life into their products. So it is with Garlock Metal Packings. Our improved iron was developed after exhaustive, accelerated-wear tests in one of America's leading universities. In actual service it has conclusively demonstrated its superiority.

Frequent periodic tests guarantee the uniformity of this quality controlled iron. These new, improved Garlock Metal Packings will give remarkably long, economical service.

The Garlock Packing Co.
Palmyra, New York

In Canada:
The Garlock Packing Company
of Canada Ltd., Montreal, Que.

**GARLOCK**



A manufacturer of pressure guns is having trouble at the Packing Point*. He tries several kinds of packings. None work. They leak. He's losing money every second his production is stopped. So he calls on Graton & Knight's packing engineers to help him —

# PUT AIR INTO GUNS

Our engineer discovers that the packing rests on a light metal support instead of a solid shoulder, to reduce manufacturing cost . . . but we point out that the assembly will never work until heavier metal backing is used. The cost increase is negligible.

The manufacturer accepts our suggestion — changes his assembly — and we make new packings for him. *Now* his pressure guns get air.

Whether it's a Pressure Gun or a 70-ton roll press, let us help you in the design stage, giving you the benefit of our experience and our "X-Ray Thinking." Graton & Knight packings are made in the Home of Research from specialized leathers that resist oil, water heat, semi-corrosive liquids, etc.

Have us send you a folder on Hydraulic and Pneumatic packings. No obligation, of course.

**The vital point in any machine using packings . . . the point that needs the protection of Graton & Knight's packing experience.*

*Graton and Knight*
**HOME of RESEARCH**

**WORCESTER, MASS.**

"X-Ray Thinking" at the Packing Point

**When you're Designing a product that will vibrate, shake or jar**

*Be sure to protect it with - - -*

**UNSHAKO**

**The Nut that can't shake loose**

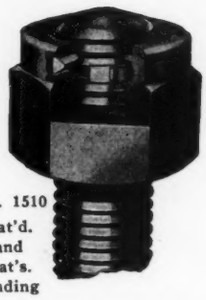


Fig. 1510 Pat'd. and Pat's. Pending

Cut-out section showing locking ring in place

Don't take chances on those three adverse factors impairing the efficiency and shortening the operating life of your product. "Unshako" Self-Locking Nuts will keep it tight as the day it's made. Their neat one-piece construction adds to the finished appearance and speeds-up production as well. Write and let us explain fully how the built-in locking ring effectively clutches the bolt whenever vibration starts and how easy these nuts are to remove with an ordinary wrench.

**STANDARD PRESSED STEEL Co.**

BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. BOX 545 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

**SAVE MONEY ON CUSTOM-MADE SMALL**

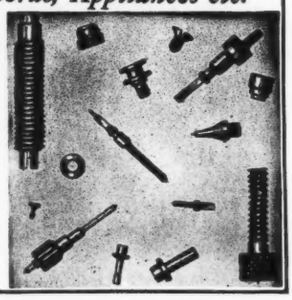
**PRECISION PARTS**

*for Instruments, Cameras, Appliances etc.*

● Our special department — equipped with high-speed automatic machines especially designed for the purpose — is prepared to handle your quantity production requirements exactly to your specifications. Send us blueprints or samples. Ask us to quote.

*Address:* Custom Parts Dept.

**WALTHAM**
WATCH COMPANY
*Waltham, Mass.*



**Continuous Operation Doesn't Strain the**

**MICRO**
**1/4 Inch Overtravel**
**Metal Clad**
**SWITCH**

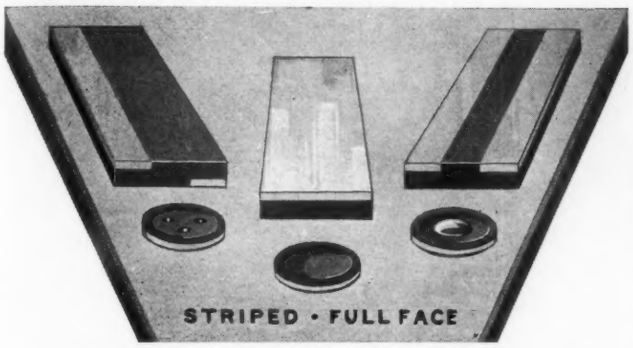
Especially suited for exacting service on automatic machinery requiring direct contact with high speed actuators. Adaptable for closed, open or double-throw circuits. Millions of operations. Sealed in a metal housing. Threaded for right or left hand angle mounting ⅛" or ⅜" straight fitting. Overall dimensions 2⅛" high, 1" wide, 3¼" long. Write for specifications and recommendations covering overtravel switch applications.

1—Movement differential under .0005".
2—Operating pressure about 8½ oz.
3—Overtravel of actuator plunger beyond operating point ¼".
4—Heater loads 1200 watts up to 600 volts A.C. Also inductive loads, solenoids, and relays, ½ H.P. up to 460 volts A.C.

Cap of 5/16" plunger is hardened and polished.

**MICRO SWITCH** — 5 EAST SPRING STREET — **MS CORPORATION** — FREEPORT, ILL., U.S.A.

# CALLITE

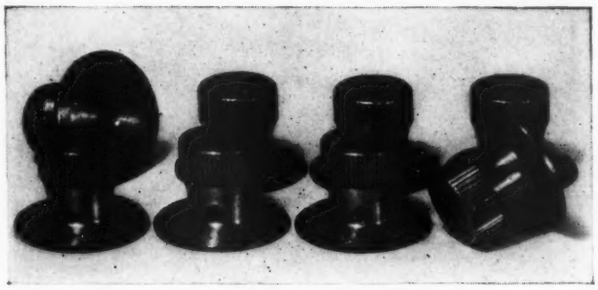



## CONTACTS OF DEPENDABILITY

**REDUCE your costs** by using **laminated contacts** of Silver, Platinum and other precious metals **firmly bonded** to Copper, Brass, Bronze, Monel Metal, etc. Your costs are kept at a minimum because only the necessary amount of precious metal is used. And yet the firm bond assures you of **greater strength** and **higher thermal conductivity.**

Buttons of all sizes and styles and strips either inlaid or full faced are made to your exact specifications. Let our skilled staff of engineers assist you in your problems. Write for additional information.

**CALLITE PRODUCTS DIVISION**
FISHER ELECTRIC CORPORATION
550 - 39th STREET — UNION CITY, N. J.



## "KNOBS"!

Smartly designed brass focal plane shutter speed knobs. Completed on the automatic except for tapping and marking. A clean-cut, well-finished job for an outstanding modern camera, and indicative of many other parts and accessories which "Peck Service" has produced, speedily and economically, for high grade instruments, appliances and special devices. But whether your product is in this classification or just an article for popular sale, it will pay you to

**SEND FOR THE PECK CATALOG**

—a book of much value to designers, engineers and purchasing agents. No charge, but please make request on your letter head.

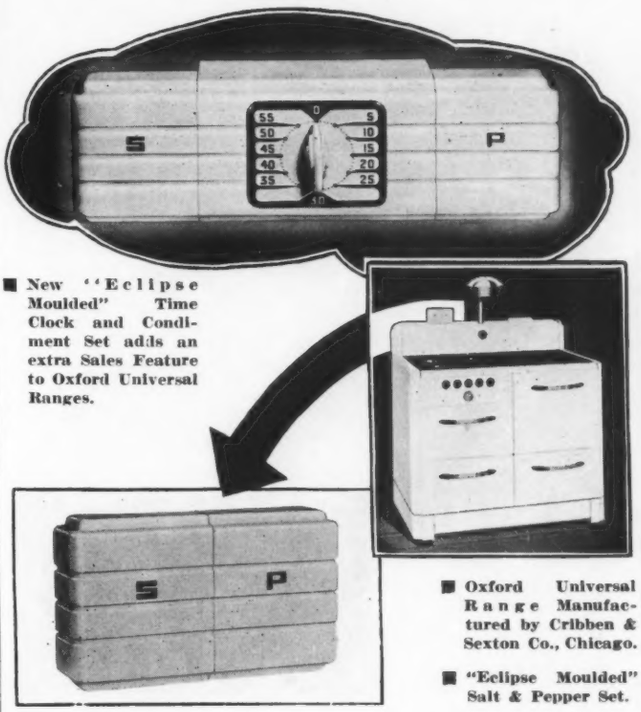
# PECK SPRINGS

**AND SCREW MACHINE PARTS**

**The Peck Spring Co.** — **14 Summit St., Plainville, Conn.**

# ECLIPSE MOULDED PRODUCTS

## *In the Kitchen . .*




■ New "Eclipse Moulded" Time Clock and Condiment Set adds an extra Sales Feature to Oxford Universal Ranges.

■ Oxford Universal Range Manufactured by Cribben & Sexton Co., Chicago.

■ "Eclipse Moulded" Salt & Pepper Set.

**An interesting feature of the set is a specially designed revolving filler opening for quick and easy filling.**

**Here is one example of Eclipse's designing and moulding service to manufacturers of Kitchen Appliances. . . Adding the "Extras" in modern accessories that provide powerful Sales Appeal.**

**Moulding the intricate and difficult shapes, affording new savings, offering new design-beauty to finished products of many kinds has been our specialty for many years.**

**Eclipse Moulded Products are saving hundreds of dollars for manufacturers in every industry—besides improving their products, in appearance and utility.**

## ECLIPSE MOULDED PRODUCTS CO.

**Milwaukee** — **Wisconsin**

**Chicago** — **Detroit** — **St. Louis**

■ **MOULDERS OF**
**Bakelite,, Durez, Resinox, Plaskon Tenite, Beetle.**

**THE Important Reason . . .**

**for Calling on Eclipse for Modern Moulded Plastics!**

**Eclipse Designers, Engineers, Craftsmen are trained in moulding ALL PLASTICS. They know which of the many available modern plastic materials will most profitably serve your needs. Call upon Eclipse for an UNBIASED recommendation.**

See the Point

Fig. 1641
Pat. app. for

. . . that
KNURLING
POSITIVELY PREVENTS
Vibration From Loosening
the

UNBRAKO

SELF-LOCKING
HOLLOW SET SCREW

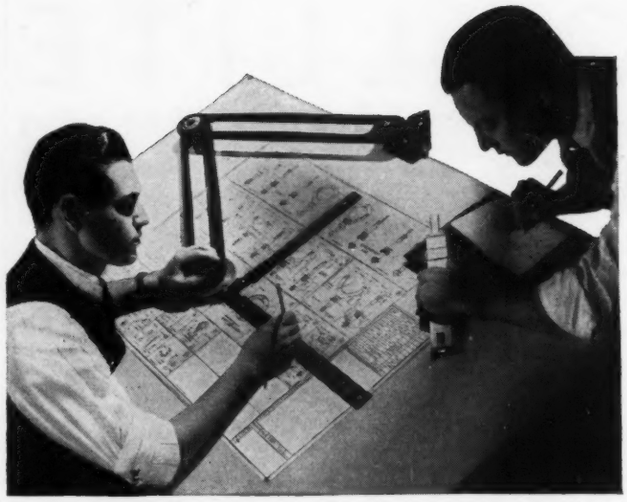
By merely tightening-up this new Cup Point Set Screw in the ordinary manner, it automatically locks itself in place and WILL NEVER VIBRATE LOOSE BY ITSELF. One important and outstanding advantage in the "Unbrako" Self-Locker is that it can be adjusted over and over again and will lock equally well every time. Another is the absolute lack of resistance offered by the knurling during tightening-up. These facts have been conclusively proven by countless tests made in many different industrial plants and under varied operating conditions.

Write for samples, prices and more information about the use of "Unbrako" Knurled-on-the-point Self-Locking Hollow Set Screws.

Fig. 1645

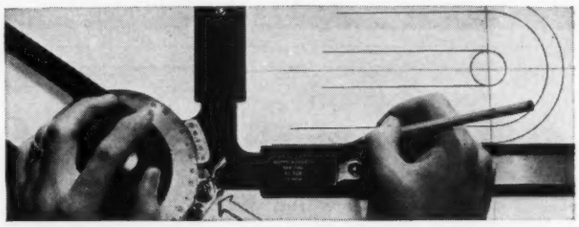
STANDARD PRESSED STEEL CO.
BRANCHES
BOSTON
DETROIT
INDIANAPOLIS
JENKINTOWN, PENNA.
BOX 545
BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO





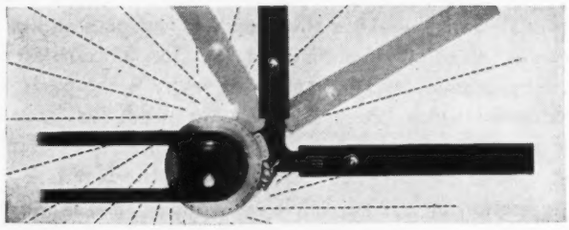
SPEEDS UP YOUR
DRAFTING TECHNIQUE

This improved drafting machine cuts down your actual drawing time 25% to 50%. All the functions of T-square or straightedge, triangles, protractor and scales are combined in one convenient unit *controlled entirely by the left hand.* All lines are drawn to exact length; no need to retrace; no "ends" to erase. Every setting of the protractor head is controlled by a single lever, directly under the left thumb. You will do better work with the Paragon Drafting Machine—and at a speed impossible with conventional drafting methods.



The more complex your drawings, the more time you save. The positive automatic stop mechanism produces any multiple of 15° at a simple motion of the protractor control. Odd angles are easily set on the vernier.

*30-day trial*—Try the Paragon Drafting Machine for yourself—under actual working conditions. Ask your K & E dealer for a 30-day free trial — or — write us for Booklet No. 49, with illustrations and prices.



K&E
PARAGON
REG. U.S. PAT. OFF.
DRAFTING MACHINES

KEUFFEL & ESSER CO.
EST. 1867
NEW YORK · HOBOKEN, N.J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · DETROIT · MONTREAL

# Don't overlook SPRINGS
## when you modernize your mechanisms

Why continue to use the same old spring in your redesigned motions without investigating the possibilities of increased performance from this part, also? • Gibson metallurgists are continually prying into the characteristics of new spring materials to determine their full range of usefulness and suitability. • This information, plus an ability to put it to practical use, has proved interesting and profitable to manufacturers of a great variety of products using springs. • The size of your order is no bar to obtaining quality springs. Gibson puts the same effort into small orders as into quantity runs. •

SPRINGS : WIRE FORMS
SMALL STAMPINGS

**WILLIAM D. GIBSON COMPANY**
DIVISION OF ASSOC. SPRING CORP. 1800 Clybourn Ave., Chicago, Ill.

# NOT THE LARGEST . . . but

## BIG ENOUGH

**To meet your specialized control requirements — any quantity as you want them — when you want them**

Above—Guardian Electric's production lines where innumerable types of control units arrive from other departments for final assembly. These may comprise relays, discs, contact combinations, stepping switches, solenoids, springs, auxiliary time delay, muting and holding relays, metal housings and brackets, and other special parts. All these flow together smoothly in the hands of competent, trained electrical workers . . . and every part is designed, fabricated, tested, and assembled in one plant . . . Guardian's!

**Engineering Laboratory**

Devoted solely to the design of electrical control units from simple to most intricate combinations . . . uniform in size . . . space-saving . . . simple, better and more economical.

Type-R Stepping Relay

*Ask Us to Make Specific Recommendations To Fit Your Special Requirements. Write For Catalog P Today!*

**GUARDIAN ELECTRIC**
1629 W. Walnut St. Chicago • Illinois

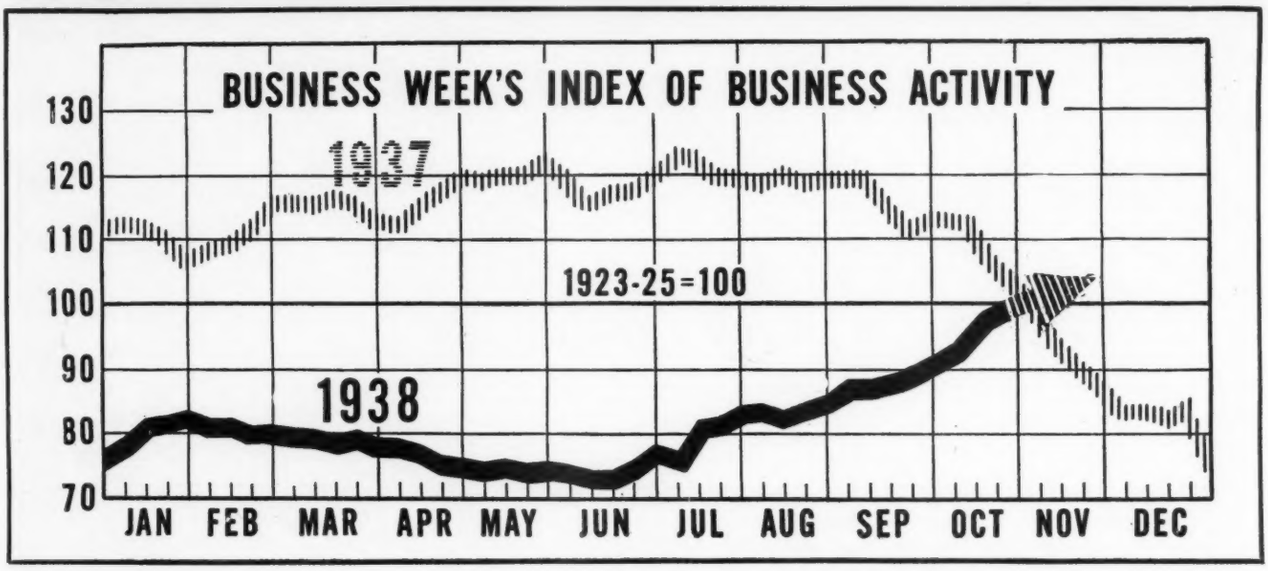
"We Use CHACE Thermostatic BIMETAL IN THE Domestic AUTOMATIC CONTACT PILOT"
DOMESTIC MANUFACTURING CO., LOS ANGELES, CAL.

The Domestic Automatic Contact Pilot is a device which prevents the main burners of a furnace from being turned on if, for any reason, the pilot flame should be extinguished. Because of its dependable performance, Chace Thermostatic Bimetal was chosen as the active element in this device. Whether the movement desired be a pushing, pulling, twisting, lifting or bending motion, Chace can give it to you—the measure of force required is met by proper selection of Bimetal element.

CHACE THERMOSTATIC BIMETAL

**W. M. CHACE CO.**
1607 Beard Avenue - - - Detroit Mich.

# WILL *YOUR* SALES CURVE




## These Forces Foreshadow Next Year's Sales Opportunities

**1.** *Strong Recovery momentum* established over the past 17 weeks —

**2.** *Government Spending* — Federal deficits which were 50 million dollars in September, 1938, are scheduled to rise to something over 600 million dollars in a single month.

**3.** *Revival of Heavy Industries* — in steel, automobile and construction. Total construction is expected to increase by at *least a billion dollars in 1939.*

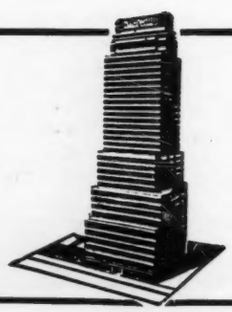
**4.** *World Armament Race* which is estimated to aggregate international expenditures of 25 billion dollars.

**5.** *Lower Costs* — In recent months many businesses have reduced expenses. With greater volume greater profits are in sight restoring incentives to expanding business.

**6.** *The Resources to Finance Recovery.* Bank deposits are high, interest rates low and FHA and RFC are ready to cooperate.

Whether this is sound permanent recovery, is another question. Here are gigantic forces bringing an upsurge in business *at least* for the first half of 1939.

Will you get your share?



*For 1939 sales* **ADVERTISE NOW in**

**McGRAW-HILL PUBLISHING COMPANY, INC., 330 West 42nd Street, New York City**

# KEEP UP WITH BUSINESS?

## Budget your 1939 Advertising on the basis of Expected Volume . . . and Start NOW to put your Sales Curve where you want it.

64% of companies operating on a *fixed percentage* basis budget advertising on "expected volume".

76% of companies operating on a *varying percentage* basis budget advertising on "expected volume".

### "Expected Volume" as Budget Basis

A comprehensive survey just released by the National Industrial Advertisers Association shows that this is the accepted practice of the majority of industrial advertisers.

## 8 "Pay" Reasons

### for Starting Your 1939 Advertising Program NOW

**1.** Insure the getting of your share of 1939 business right at the start.

**2.** Stimulate your salesmen to take full advantage of increasing business activity.

**3.** Many long-pending orders for capital goods will soon be moving. Advertising will help to move them . . . your way.

**4.** Next year's orders are in the making *now* — you can beat your competitor who is still marking time, by intensifying your advertising effort first.

**5.** As business improves, costs will inevitably tend to rise. You can cut your future selling costs by advertising now.

**6.** New uses and new markets for old products are being opened up today.

**7.** Advertising now will most quickly reach and influence the new men in your customers' and prospects' organizations.

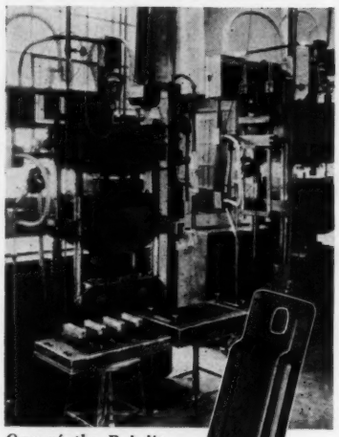
**8.** Advertising will bring your message to the influential "inside" men, who are getting harder to see, as production activity increases its pace.

# McGRAW-HILL PUBLICATIONS

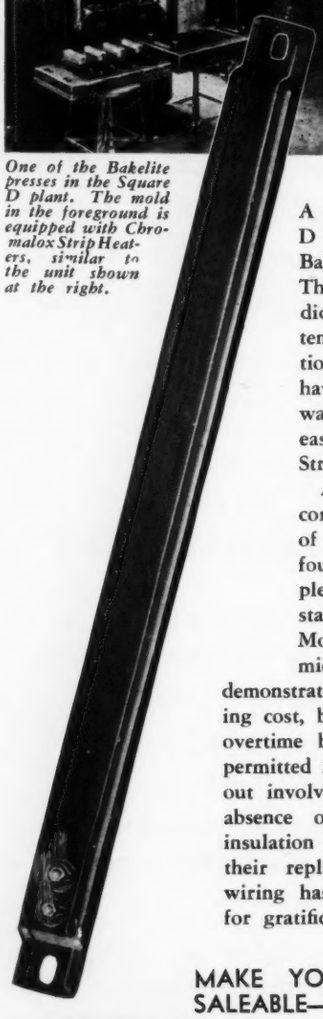
ATLANTA • BOSTON • CHICAGO • CLEVELAND • DETROIT • LONDON • PHILADELPHIA • SAN FRANCISCO • ST. LOUIS • WASHINGTON

# CHROMALOX

## ELECTRIC HEATING UNITS



*One of the Bakelite presses in the Square D plant. The mold in the foreground is equipped with Chromalox Strip Heaters, similar to the unit shown at the right.*



## *prove the right way to heat Bakelite molding presses*

A real problem faced the Square D Company when they installed Bakelite molding equipment. The steam pressure available did not develop high enough temperature for the job. Additional boiler equipment would have been costly. Electric heat was definitely indicated as the easy way out. And Chromalox Strip Heaters proved it.

Although the molds were cored for steam, the installation of electric strip heaters was found to be comparatively simple — a very common circumstance with these handy units. Moreover, additional economies in their use were quickly demonstrated, not only in direct operating cost, but also in the elimination of overtime boiler room cost, which thus permitted 24-hour plant operations without involving this expensive item. The absence of leaking steam joints, of insulation problems, heat loss, etc., and their replacement by simple electrical wiring has been another sound reason for gratification in the Square D plant.

●

### MAKE YOUR EQUIPMENT MORE SALEABLE—WITH ELECTRIC HEAT

CHROMALOX

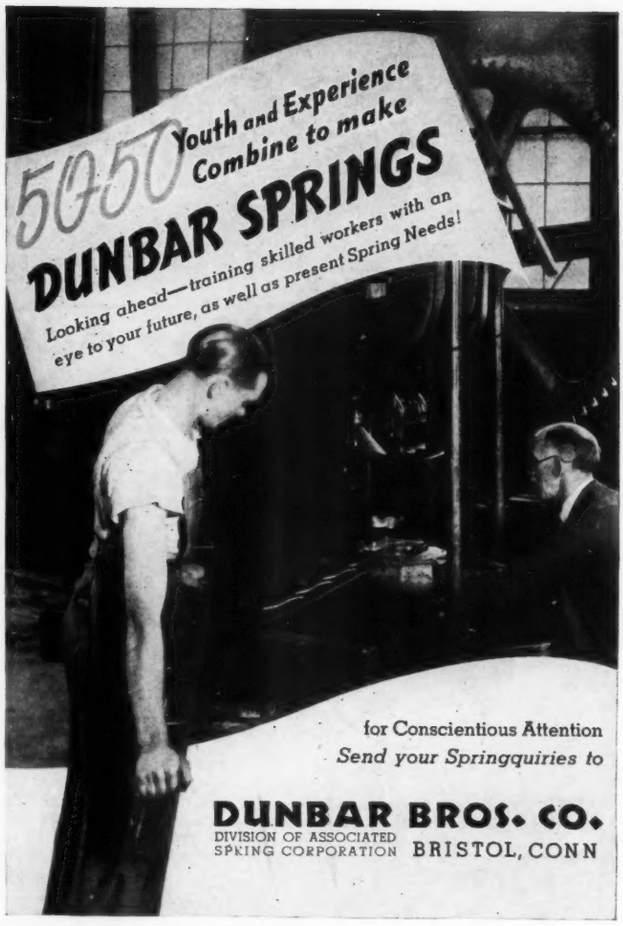
If you manufacture equipment in which heat is a requisite, check on the Chromalox units which will provide it, and make its installation and operation simpler and less costly. The Chromalox Book of Electric Heat gives valuable data, diagrams and graphs on industrial electric heat. The coupon below brings it.

*Mail With Your Business Letterhead*

**EDWIN L. WIEGAND COMPANY**
**7535 Thomas Blvd. Pittsburgh, Pa.**

**Send me the CHROMALOX BOOK OF ELECTRIC HEAT**

**Name** .....**Position** .....12


50-50 Youth and Experience Combine to make
DUNBAR SPRINGS
Looking ahead—training skilled workers with an eye to your future, as well as present Spring Needs!
for Conscientious Attention
Send your Springquiries to
DUNBAR BROS. CO.
DIVISION OF ASSOCIATED SPRING CORPORATION
BRISTOL, CONN

# *It can be Done Better by You*

A registering instrument or counter is necessary to the efficient operation of many production machines. The trend is away from leaving it to the user to hang on motors, control, lighting, counters — and toward building them into the machine — making a real job of it.

*Productimeters* are made by the largest exclusive counting machine manufacturer in the U. S. They are built to last as long as the machine and require minimum attention. "Equipped with *Productimeters*" is one more good sales point for your machines.

**Productimeters** THE SPEEDOMETERS OF INDUSTRY **DURANT MFG. CO.**
**1938 N. Buffum St. Milwaukee, Wis.**

## LET OUR EXPERIENCE INCREASE YOUR 1939 PROFITS

Here at Auburn we've been handed a lot of tough plastic molding jobs. Some have been tougher than others. But together they spell experience —more than 60 years of it—all yours to profit by in 1939.

Each of these jobs has had its share in showing us how to give greater value, often at less cost. From them we've learned the importance of frequent and rigid inspections. The sales records of our customers' products tell the rest of the story.

Let us add your product to that list. It will pay you to order your 1939 molded plastics from Auburn.

ESTABLISHED 1876

MOLDED PLASTICS DIVISION OF
**AUBURN BUTTON WORKS, Inc.**
AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Rochester, Boston


# SEARCHLIGHT SECTION

### POSITION VACANT

A LEADING MACHINE TOOL MANUFACTURER requests particulars covering a machine designer having at least eight to ten years actual machine designing experience. Furnish reference, where employed during that time and what capacities held during time of employment. P-132, Product Engineering, 330 W. 42nd St., New York, N. Y.

### Executive Mechanical Engineer

On behalf Eastern client; manufacturers heavy industrial equipment, we are seeking a graduate executive mechanical engineer. Must have principal experience in heavy equipment industries; good record of original design: experience in preparing and cooperating with attorneys on patent applications: reasonable amount shop experience: proven executive ability: Not more than forty-five years old with present earning of not less than $7,500 per year. This post represents an exceptional opportunity for the right man. Reply by letter to the undersigned giving complete details of education and experience. All replies will be treated absolutely confidential.

**GEORGE S. ARMSTRONG & CO., Inc..**
*Industrial Engineers and Management Consultants*
**52 Wall Street** **New York, N. Y.**

# PROFESSIONAL SERVICES

**FOSTER D. SNELL, INC.**
*Chemists—Engineers*
Every Form of Chemical Service
305 Washington St. Brooklyn, N. Y.

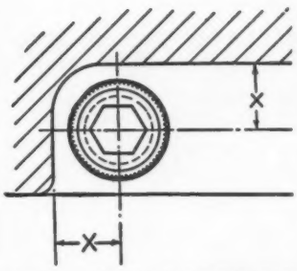

# Most Designers say "KNURLED UNBRAKO SOCKET HEAD CAP SCREWS

*Fig. 1434 Patents Pend'g*

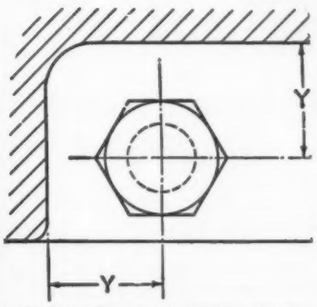
**give a better appearance to the finished product."**

These cap screws with their distinctive "Unbrako" heads really dress-up any piece of equipment on which they are used. This is not our "say-so" only, but the unbiased opinion of a number of engineers and designers in varied lines of industry. Write us for a sample. You'll quickly see why this is true.

## It often fits where a hex head won't




See how the Knurled "Unbrako" snuggles right into the corner.



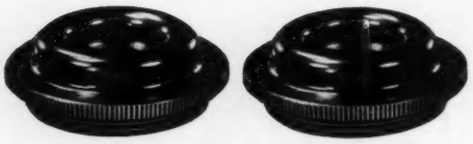

Notice the great open spaces necessary for the hex-head and wrench.

Many times, no doubt, you've had the problem of getting a screw into a tight spot, where there just wasn't enough room to apply an ordinary hex wrench. That is where "Unbrakos" can help you out.

Their special wrench can be slipped into almost unbelievably small apertures and thus easily solve what would otherwise be a tough problem. See the plan views at the left. Let us tell you exactly how "Unbrako" can fit in with your needs. Write for the details.

**STANDARD PRESSED STEEL Co.**
BRANCHES JENKINTOWN, PENNA. BRANCHES
BOSTON CHICAGO
DETROIT ST. LOUIS
INDIANAPOLIS Box 545 SAN FRANCISCO

# *Designers* SAVE MONEY, SPEED ASSEMBLY *when they put it up to "Brandywine"*



## NO MORE DELAYS

The two parts shown above are identical in size, shape and purpose. (A) was made in Germany of a molded synthetic resin for a well-known manufacturer of electrical appliances. This insulated cap frequently chipped or cracked and caused both dissatisfaction and delay. (B) is our solution to this problem — formed, knurled and threaded fibre tubing with a finish like polished jet. It will stand unusual abuse, it cost no more than the foreign article and a year's supply can be shipped in 48 hours!

SHOWN here are typical examples of how our long experience with one product — Brandywine Fibre Tubing — can assist manufacturers in "cutting corners" without cutting quality. Perhaps this versatile material can be applied to your product in a way that will effect both savings and improvement . . . It won't cost you a cent to find out!

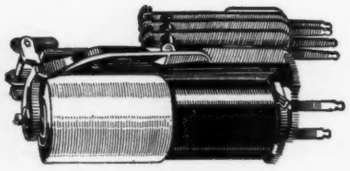
## HERE'S A TIME AND MONEY SAVER

Not so long ago the makers of this industrial lamp extension had to tap the cord exits and screw in a threaded socket. Now, thanks to "Brandywine's" way of doing things, they merely drill the holes and insert *split* cord insulation bushings which expand to form a tight, neat fit. They cost less to buy, less to assemble and do the job equally as well.

***Send Sample or Blueprint and let US determine if it can be made from fibre tubing.***

# BRANDYWINE FIBRE PRODUCTS CO.
## 1404 Walnut Street, Wilmington, Delaware

# RELAYS
## *by* AUTOMATIC ELECTRIC



When you buy an Automatic Electric Relay you get a precision product designed and constructed by an **experienced** company — for Automatic Electric has been making relays for over forty years!

## For EVERY Industrial Need

● The Automatic Electric line of relays includes quick and delayed action types, sensitive and heavy duty types, mechanical locking types, polarized relays, etc. Available with any contact combination and for operation on D.C. or A.C. circuits of any voltage.

● **Write for complete illustrated catalog of relays, stepping switches, electric counters, solenoids, keys, and other electrical control accessories. Address American Automatic Electric Sales Company, 1033 W. Van Buren St., Chicago.**

**AUTOMATIC ELECTRIC**

MAKERS OF TELEPHONE & SIGNALING APPARATUS
ELECTRICAL ENGINEERS, DESIGNERS AND CONSULTANTS

# YOUR CAREER . . .

. . . is our *first* interest.

KEEP ABREAST with the latest trends in design engineering and product development.

READ

PRODUCT ENGINEERING

*To Users of*
## HYDRAULIC EQUIPMENT

A new folder just published, gives complete information on a new line of hydraulic control panels and control valves. These panels and valves now make it possible for designers of hydraulic equipment to obtain advantages never before available. The control panels require no dogs or cams and can be placed anywhere. They eliminate hazards because when fuses blow or switches fail, hydraulic cylinders are automatically stopped. It will pay you to investigate this new equipment before designing your next hydraulic setup.

*Send today for literature*

**HYDRAULIC HI-SPEED COMPANY**
**2657 S. Telegraph Road** **Dearborn, Michigan**

# The Key to Remote Control

**WRITE FOR THIS FREE FOLDER**

***It contains engineers' drawings and complete information***

● Here is a folder of valuable facts for anyone planning the installation of *remote control* impulse-transmission in any product. Write for it.

The TRU-LAY Push-Pull Control consists of a Preformed Cable encased in a flexible, non-compressible steel covering. This is protected by a grease-tight and water-tight flexible housing. The entire assembly operates smoothly, quietly in a bath of grease. Operation is sensitive and rattle-proof. No toggles, pins or cotters used.

Write for descriptive folder, "The Key to Remote Control," and consult our engineers on any remote control problems.

**AMERICAN CABLE DIVISION**

●

**AMERICAN CHAIN & CABLE COMPANY, INC.**

12-252 General Motors Bldg., Detroit, Michigan

San Francisco
630 Third Street

CONSULT TRU-LAY ENGINEERS ON REMOTE CONTROL PROBLEMS

*In Business for Your Safety*

ACCO

**TRU-LAY Push → ← Pull CONTROLS**

# MAKE YOUR OWN BLUEPRINTS

*in less than 3 minutes*

**WITH THE NEW WICKES CONTINUOUS BLUEPRINTER**

**Here are the facts about the speedy new Wickes Vapor-Tube, Continuous Printer:**

**Makes blueprints, black and whites, Ozalids and Van Dykes up to 42" wide in sheets or continuous rolls of any length. Makes sharper, cleaner prints without spots or streaks because paper is rolled around (not slipped past) Pyrex glass cylinder.**

**Requires less current — because single mercury vapor-tube lamp gives maximum light efficiency on entire circumference of Pyrex glass cylinder.**

**Why pay others to make your prints when you can purchase this moderately priced printer and cut your costs in half?**

**WICKES BROS.**
**SAGINAW, MICHIGAN**

**MAIL THIS COUPON TO DAY**

**WICKES BROTHERS,**
**Saginaw, Michigan:**

**We are interested in getting prices and further facts about the new Wickes Simplex Printer.**

**Name** .....

**Company** .....

**City and State** .....

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A McGRAW-HILL PUBLICATION

## New Departure Spindle Bearings after 10 years of steady work

● These New Departure Spindle Bearings went to work in a new tool room lathe.* That was ten years ago. They didn't want a soft job—and they didn't get it. Year after year, two and three shifts a day, they were kept at work, much of it at high speeds with carboloy tools. Except for lubrication, they received no attention whatsoever. In ten years they had accomplished work that normally would require over twenty years time. They were mighty good bearings, but today New Departure makes them still better—more accurate—fit components for the finest of machine tools.

** Details upon request.*

2723

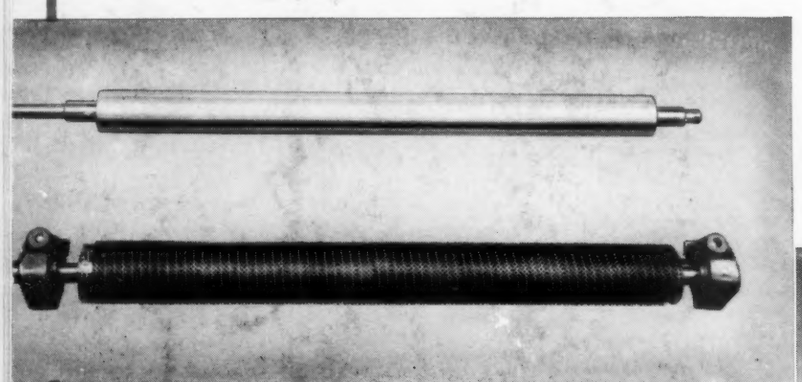
**NEW DEPARTURE Ball Bearings**

*New Departure · Division General Motors Corporation · Bristol, Connecticut*

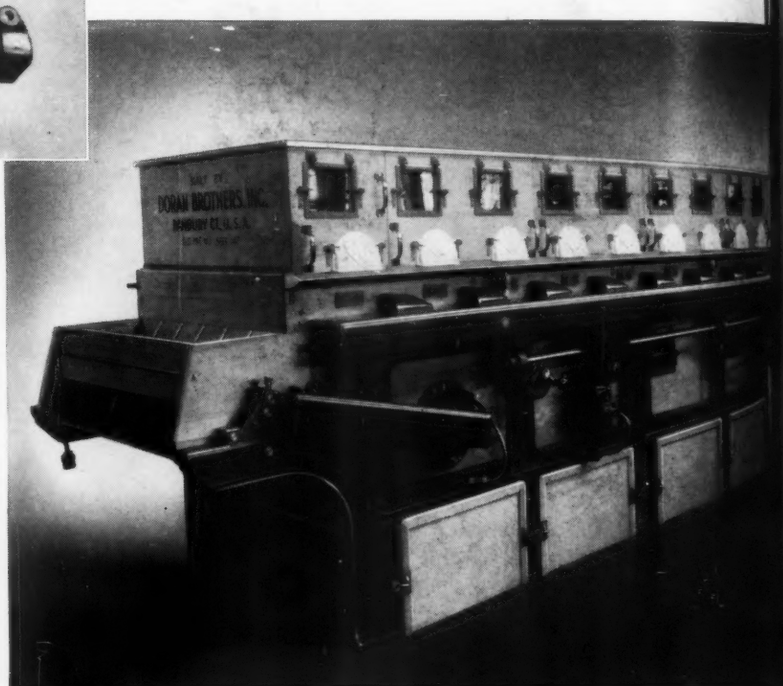
NOTHING ROLLS LIKE A BALL

# Dowmetal Gives This Product

# LIGHTNESS PLUS Lower Cost



*This is one of nine DOWMETAL picker rolls that.....*



*...cut the cost of making and operating this machine.*

DOWMETAL'S* extreme lightness plays an important part in hat making machinery produced by Doran Brothers, Inc.

In their fur blowing and cleaning machine the extreme lightness of DOWMETAL has cut nearly 200 pounds of weight from the nine picker rolls that revolve at 4200 r.p.m. It has reduced starting load and power requirements to such an extent that standard motors now replace the special motors formerly used.

But that's not all. The ease of machining DOWMETAL has cut the cost of finishing these rolls by a full third!

Assembly and repair operations are greatly simplified by fabricating the long chain and gear guard on the side of the machine of DOWMETAL. The exceptional lightness of this large piece enables a single man easily to remove and replace it. Similarly, the lightness of the DOWMETAL picker rolls has greatly reduced the time required to balance them.

This is only one of countless examples of how DOWMETAL'S extreme lightness, combined with great strength and ready machinability, has made possible better products and lower costs. Investigate DOWMETAL for *your* products. Write for the illustrated DOWMETAL booklet—"Industry's Lightest Structural Metal"—today.

THE DOW CHEMICAL COMPANY

Midland • *Dowmetal Division* • Michigan

*Branch Sales Offices:* 30 Rockefeller Plaza, New York City; Second and Madison Streets, St. Louis; Field Building, Chicago; 1400 16th Street, San Francisco; 2260 East 15th Street, Los Angeles

DOWMETAL

MAGNESIUM ALLOYS

LIGHTEST OF ALL STRUCTURAL METALS

DOWMETAL *is available in sand, permanent mold and die castings, sheet, strip, plate, forgings, standard and special extruded shapes. It is one of the easiest of all metals to machine.*

*Reg. U. S. Pat. Off.